Engineering Library

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The Engineer.

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VOL. CXLVI.—No. 3801] LONDON: FRIDAY EVENING, NOVEMBER 16, 1928 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

REFRIGERATION.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Tuesday, 4th December, 1928, for REFRIGERATING EQUIPMENT (ammonia type) in the Non-insulated Store, Fruit Storage Testing Station, East Malling, Maidstone.

Drawings, specification, a copy of the conditions and form of contract and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 236

COMPRESSION TESTING MACHINE AND WEIGHBRIDGE.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Wednesday, 5th December, 1928, for (a) 500-TON COMPRESSION TESTING MACHINE; (b) a 20-TON WEIGHBRIDGE at the Ministry of Transport, Colnbrook, Slough.

Drawings, specification and a copy of the conditions and form of contract and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea in each case. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 237

The Director-General, India Store Department, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for—

40 Tons STEEL FISH BOLTS and NUTS.

Tenders due on the 27th November, 1928.

Forms of Tender obtainable from the above at a fee (which will not be returned) of 5s. for each schedule. 245

Assistant Engineers REQUIRED for the KENYA and UGANDA RAILWAY for a tour of 20-30 months' service, with possible extension. Salary £480, rising to £720 a year by annual increments. Free quarters and passages and liberal leave on full salary. Outfit allowance of £30 on first appointment. Candidates, 22-28 years of age, unmarried, must have passed Examination to qualify for Associate Membership of the Institution of Civil Engineers or hold professional qualifications recognised by the Institution as exempting from Parts A and B of that examination; should have had some experience on Railway Civil Engineering Works.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/999. 215

Deputy Resident Engineer REQUIRED by the GOVERNMENT of NIGERIA for the Benue Bridge Contract, for two tours of 12 to 18 months' service. Salary £1100, rising to £1250 a year by annual increments of £50, plus £220 a year duty pay. Free quarters and passages and liberal leave on full salary. Candidates, not over 45 years of age, must be fully qualified Civil Engineers and must have had large previous experience of Steel Bridge Erection and Heavy Foundations.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/1159. 187

The Government of INDIA REQUIRE ASSISTANT FOREMAN for RIFLE FACTORY, ISHAPORE.

(APPOINTMENT 104A).—Qualifications: Five years' apprenticeship and subsequent experience of rifle barrel manufacture. Capable of controlling labour. Preference will be given to candidate with experience of both rifle and machine gun barrel manufacture. Age 25-32 years. Unmarried man preferred.

Salary, Rs. 450-15-510 per calendar month, with prospect of further increases. Provident Fund. Terms: Agreement for five years in first instance. Free second-class passage to India and return passage on satisfactory termination of services. Free quarters. Medical examination.

Further particulars and forms of application may be obtained (on request by postcard, quoting the number of the appointment) from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 24th November, 1928. 195

The High Commissioner FOR INDIA is prepared to receive APPLICATIONS for an APPOINTMENT as an AGRICULTURAL ENGINEER in the Burma Agricultural Department.

The appointment will be made temporarily on agreement for three years in the first instance, with the prospect, subject to satisfactory service, of transfer to permanent employment. Candidates must be between 23 and 30 years of age. They should possess a University Degree in Mechanical Engineering. Preference will be given to candidates who have had special experience in connection with agricultural engineering work. The duties of the post consist of research with a view to improving the indigenous implements of cultivation, in the examination of machinery at present in use in industries connected with agriculture with a view to its improvement, in the supervision of such teaching in engineering as may be necessary at the Agricultural College, Mandalay, and in dealing with problems in agricultural engineering which may arise from time to time.

Pay will be admissible in accordance with an age scale, e.g.—Age 23 years, Rs. 800 per month plus overseas pay of £20 per month; 29 years, Rs. 600 per month plus overseas pay of £30 per month. The permanent scale rises by annual increments of Rs. 50 up to a maximum of Rs. 1500 plus overseas pay of £40 per month, with possibilities of further advancements (overseas pay is admissible only to an officer of non-Asiatic domicile).

Further particulars and forms of application may be obtained, upon request by postcard, from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications, 14th December, 1928. 180

The Engineer

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PUBLIC NOTICES

Technical Assistants (TWO), One Electrical Engineer, One Mechanical Engineer (unpensionable) Salary £150, rising to £230 per annum, plus Civil Service bonus, giving total at present of about £227 to £328. Candidates must be British subjects.

Age 24½-27 years. Preference and a certain age concession to ex-Service men. Possession of Degree in Engineering or Certificates of equivalent examination essential; also suitable workshop training.

Application forms, returnable by 8th December, 1928, may be obtained on application to CHIEF SUPERINTENDENT OF ORDNANCE FACTORIES, Royal Arsenal, Woolwich, S.E. 18. 238

Armourers' and Braziers' COMPANY.

LECTURES IN METALLURGY.

The Company have arranged for the following Lectures to be delivered:—

At the Sir John Cass Technical Institute, 31, Jewry-street, Aldgate, E.C., at 8.15 p.m. on 28th November, 5th and 12th December, 1928, by S. W. SMITH, Esq., D.Sc., A.R.S.M., on "CERTAIN ASPECTS OF THE SOLIDIFICATION OF METALS AND ALLOYS."

At the Borough Polytechnic Institute, St. George's-circus, S.E. 1, at 5.30 p.m. on 29th November, 7th and 14th December, 1928, by C. A. EDWARDS, Esq., D.Sc., on "THE MANUFACTURE OF TIN-PLATE."

Admission free, without ticket. 198

University of Durham.

ARMSTRONG COLLEGE, NEWCASTLE-UPON-TYNE.

LECTURESHIP IN CIVIL ENGINEERING.

The Council of Armstrong College invites APPLICATIONS for a LECTURESHIP in CIVIL ENGINEERING. Salary £350 to £400, according to qualifications. Candidates must have had practical experience and have a good knowledge of surveying. Duties to commence on 8th January, 1929. Ten copies of applications and of not more than three testimonials should be lodged, not later than Tuesday, 27th November, 1928, with the undersigned, from whom further particulars may be obtained.

J. Y. T. GREIG, Registrar.

Armstrong College. 184

PUBLIC NOTICES

Armstrong College, NEWCASTLE-UPON-TYNE.

(IN THE UNIVERSITY OF DURHAM.)

COURSES for the PASS DEGREE of B.Sc. and the HONOURS DEGREE of B.Sc. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.

The engineering laboratories have recently been extended, and all Departments are equipped for advanced tutorial and research work.

Full particulars of the Courses may be had on application to

THE REGISTRAR, Armstrong College, Newcastle-upon-Tyne. 223

Borough of Richmond (Surrey). WATER DEPARTMENT. CAST IRON PIPES.

The Corporation invite TENDERS for the SUPPLY of about 25 TONS of 6in. dia. CAST IRON SOCKET and SPIGOT STRAIGHT PIPES, and about ¼ TON of CAST IRON SOCKET IRREGULARS.

General conditions, specification and form of Tender may be obtained from the Engineer, Mr. Hugh P. Williamson, M.C., M. Inst. C.E., Hotham House, Heron Court, Richmond, Surrey, on deposit of £1, which will be refunded on receipt of a bona fide Tender and the return of all documents supplied.

Sealed Tenders, on the form provided, endorsed "Tenders for Cast Iron Pipes," must be delivered to the undersigned not later than Noon on November 26th, 1928.

The Council do not bind themselves to accept the lowest or any Tender.

EDWIN M. NEAVE, Town Clerk.

Town Hall, Richmond, Surrey, 14th November, 1928. 229

PUBLIC NOTICES

In the High Court of Justice, Chancery Division, Mr. Justice Maugham. 1928 M. 044.

In the matter of the NORTH-WESTERN ANGLO-SWEDISH ELECTRIC WELDING COMPANY LIMITED AND REDUCED and In the matter of the COMPANIES (CONSOLIDATION) ACT 1908.

Notice is Hereby Given that the ORDER of the HIGH COURT of JUSTICE CHANCERY DIVISION, dated the 30th October 1928, CONFIRMING the REDUCTION of the CAPITAL of the above-named Company from £30,000 to £15,000 and the minute approved by the Court showing with respect to the share capital of the Company as altered the several particulars required by the above Act, WERE REGISTERED by the REGISTRAR of COMPANIES on the 12th day of NOVEMBER 1928. The said minute is in the words and figures following:—

"The Capital of the North-Western Anglo-Swedish Electric Welding Company Limited and Reduced is henceforth £15,000 divided into 30,000 shares of 10s. each instead of the former capital of £30,000 divided into 30,000 shares of £1 each. At the time of the registration of this Minute 18,952 of the shares of the Company of £1 each Nos. 1 to 18,202 and 19,203 to 19,952 all numbers inclusive are issued and are to be deemed to be fully paid up except that there are arrears of calls on the following shares that is to say:—

Denoting numbers of shares.	Amount of calls in arrear.
453 to 652 both inclusive	2/6 per share
3353 to 3552 both inclusive	10/- per share

The right to recover the arrears due in respect of calls on the shares of the Company prior to reduction is expressly reserved by the Order of the High Court of Justice Chancery Division made In the Matter of the above-named Company and dated 30th October 1928. At the time of the registration of this Minute the residue of the said Shares namely 11,048 shares are unissued."

Dated this 15th day of November 1928.

NICHOLLS and CO., 17, Farringdon-street, E.C. 4. Solicitors for the said Company. 244

City of Stoke-on-Trent. ELECTRICAL ENGINEER'S DEPARTMENT. CONTRACT NO. 2838.

TENDERS are INVITED for the RE-ARRANGEMENT of the COLD WATER SUPPLY SYSTEM at the Bucknall Infectious Diseases Hospital.

Specification and Tender form may be obtained on application in writing to the City Electrical Engineer, St. George's Chambers, Kingsway, Stoke-on-Trent, on payment of £2.

Tenders must be delivered to the undersigned in the envelope provided not later than the first postal delivery on Monday, 17th December, 1928.

E. B. SHARPLEY, Town Clerk.

Town Hall, Stoke-on-Trent, 12th November, 1928. 191

County Borough of Halifax. ELECTRICITY DEPARTMENT. BOILER-HOUSE PLANT.

The Halifax Corporation are prepared to receive TENDERS for the SUPPLY and ERECTION of TWO WATER-TUBE BOILERS, together with SUPER-HEATERS, MECHANICAL STOKERS, ECONOMISERS, AIR HEATERS, FEED PUMPS, and ONE STEEL BUILDING for housing of same.

Specification and form of Tender may be obtained on application to the Engineer and Manager, Electricity Offices, Town Hall-street East, Halifax, upon payment of a deposit of £2, which will be returned only after a bona fide Tender has been received.

Sealed Tenders, endorsed "Tender for Boiler-house Plant," must be delivered to the undersigned not later than Friday, December 7th, 1928.

The Council do not bind themselves to accept the lowest or any Tender.

PERCY SAUNDERS, Town Clerk.

Town Hall, Halifax, 13th November, 1928. 202

County Borough of Halifax. ELECTRICITY DEPARTMENT. TURBO-GENERATOR.

The Halifax Corporation are prepared to receive TENDERS for the SUPPLY and ERECTION of ONE 6500-kW M.C.R. GENERATOR and AUXILLARIES at the Foundry-street Generating Station, Halifax.

Specification and form of Tender may be obtained on application to the Engineer and Manager, Electricity Offices, Town Hall-street East, Halifax, upon payment of a deposit of £2, which will be returned only after a bona fide Tender has been received.

Sealed Tenders, endorsed "Generating Plant," must be delivered to the undersigned not later than Friday, December 7th, 1928.

The Council do not bind themselves to accept the lowest or any Tender.

PERCY SAUNDERS, Town Clerk.

Town Hall, Halifax, 13th November, 1928. 203

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PUBLIC NOTICES

County Borough of Belfast.

TO CONTRACTORS.

STORM WATER PUMPING STATION, GREGG'S QUAY.

The Improvement Committee invite TENDERS from competent contractors for the SUPPLY and ERECTION of No. 4 MOTOR-DRIVEN CENTRIFUGAL PUMPS, to deliver a total of 50,000 gallons per minute, with AUTOMATIC SWITCHGEAR, OVERHEAD TRAVELLING CRANE, and other Appliances.

Copies of the general conditions may be seen and Tender form, plan and specification obtained at the office of the City Surveyor, City Hall, Belfast.

Sealed Tenders, on forms provided, accompanied by plans and specifications, all enclosed in special envelope provided, endorsed with the name and address of the firm tendering and marked "Tender for Plant, Gregg's Quay Pumping Station," to be lodged or posted so as to arrive in the office of the undersigned not later than 11 a.m. on Tuesday, 27th November, 1928.

Parties tendering must comply with the Council's Standing Orders relating to wages, hours of labour, &c.

An official receipt must be obtained for every Tender delivered by hand. Tenders sent by post must be registered.

The lowest or any Tender will not necessarily be accepted.

R. MEYER,
Town Clerk.

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Great Southern Railways.

STEEL WORK FOR BRIDGES.

The Directors are prepared to receive TENDERS for the SUPPLY and DELIVERY of approximately 370 TONS of STEEL WORK for BRIDGES, consisting chiefly of Plate Girders, Pressed Troughing, and Broad Flange Beams.

Specification and drawings can be obtained on payment of £1 1s. (which is not returnable) from the Chief Engineer, Mr. J. F. Sides, M.I.C.E., Broadstone Station, Dublin, C. 16.

The Directors do not bind themselves to accept the lowest or any Tender.

Tenders, in envelopes endorsed "Tender for Steel Work for Bridges," must reach the undersigned not later than 5 p.m. on Friday, 14th December, 1928.

H. S. COE,
Secretary.

Kingsbridge Station, Dublin, W. 6,
November, 1928. 230

Great Southern Railways Company (IRELAND).

STEEL FISH-PLATES AND CAST IRON SOLE-PLATES.

The Directors of the Great Southern Railways Company (Ireland) are prepared to receive TENDERS for the SUPPLY of the following:—

140 TONS STEEL FISH-PLATES for 95 lb. F.B. Rails.

1300 TONS CAST IRON SOLE-PLATES for Ditto.

Forms of Tender (on which alone offers will be considered) with specifications and drawings can be obtained on application to the Company's Stores Superintendent, Inchicore, Dublin, on payment of Two Shillings and Sixpence each.

Tenders should be forwarded in the envelopes provided for the purpose so as to reach the undersigned not later than 5 p.m. on Wednesday, 28th November, 1928.

The Directors do not bind themselves to accept the lowest or any Tender.

H. S. COE,
Secretary.

Kingsbridge Station, Dublin,
November, 1928. 177

Metropolitan Water Board.

TENDERS FOR THE SUPPLY AND ERECTION OF PUMPING MACHINERY, AT THE WOODFORD PUMPING STATION, FOREST-ROAD, WOODFORD, ESSEX.

The Metropolitan Water Board invite TENDERS for the SUPPLY and ERECTION of THREE HIGH-COMPRESSION HEAVY OIL ENGINES, of approximately 200 B.H.P. each, with reciprocating pumps, &c., at their Woodford Pumping Station, Forest-road, Woodford, Essex.

Forms of Tender, conditions of contract, specification and drawings may be inspected without payment of a fee at the Offices of the Board, Chief Engineer's Department (Room 172), on and after Monday, 19th November, 1928.

Contractors desirous of Tendering may obtain the necessary documents from the Chief Engineer on production of an official receipt for the sum of three guineas, which must be deposited with the Accountant to the Board, and which will be returned on receipt of a bona fide Tender accompanied by all the abovenamed documents and drawings. Such payments and applications must be made between the hours of 10 a.m. and 4 p.m. (Saturdays 10 a.m. and 12 Noon). Cheques must be made payable to the Metropolitan Water Board and not to individuals.

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Machinery, Woodford," must be delivered at the Offices of the Board (Room 123) not later than 11 a.m. on Monday, 7th January, 1929.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1,
7th November, 1928. 241

Parish of Fulham.

TO CONTRACTORS AND OTHERS.

The Guardians of the Parish of Fulham desire to receive TENDERS from contractors for the INSTALLATION of 2 ELECTRIC LIFTS at their Hospital, St. Dunstan's-road, W. 6.

Persons desiring to Tender may obtain a specification and form of Tender on application to the undersigned by forwarding a stamped addressed foolscap envelope.

Tenders, properly endorsed, must be returned not later than 2.30 p.m. on Thursday, 22nd November, 1928.

L. PRICHARD,
Clerk to the Guardians.

129, Fulham Palace-road,
London, W. 6. 188

South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

1. POINTS and CROSSINGS, &c.
2. STEEL CRANKED FISH-PLATES.
3. STEEL BEARING PLATES for F.B. RAILS.
4. DOG SPIKES, SCREW SPIKES, FISH-BOLTS and NUTS.
5. SCREWS and NAILS.
6. LAMP FITTINGS and GLASSES.
7. SHEET and PLATE GLASS, &c.
8. JIB CRANES.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Points and Crossings, &c.," or as the case may be, with the name of the firm tendering, must be left with the undersigned not later than Twelve Noon on Friday, the 7th December, 1928, in respect of Specification No. 1, and not later than Twelve Noon on Friday, the 30th November, in respect of Specifications Nos. 2 to 8.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of :—

£1 for each copy of Specification No. 1.
10s. for each copy of Specifications Nos. 2, 3 and 4.
5s. for each copy of Specifications Nos. 5 and 6.
2s. 6d. for each copy of Specifications Nos. 7 and 8.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, Westminster, S.W. 1,
14th November, 1928. 243

PUBLIC NOTICES

JOHN HOLLOWAY,

M.I. Mech. E., M.I.E. & S. Scot.

Formerly Works Manager, Messrs. James Howden & Co., Ltd. Works General Manager, North British Diesel Engine Works, Ltd.

Specialist in WORKS PLANNING, EQUIPMENT, PLANT LAY-OUT, and ORGANISATION to ensure Maximum Production at Minimum Cost.

Invites enquiries for New Works, Extensions, and Reorganisation of Existing Plant and Methods.

Recent contracts with well-known firms successfully carried out

Inspection and Valuation for Insurance, etc.

Full particulars and terms on application.

Address :—

Sentinel House, Southampton Row, London, W.C.1.

Nairobi Corporation, Kenya COLONY.

TENDERS are INVITED for the SUPPLY of INCINERATING PLANT to deal with the town's refuse.

Particulars of requirements and details of local conditions can be obtained from the undersigned not later than Monday, 3rd December, 1928.

The lowest or any Offer may not be accepted.

CARTERS (MERCHANTS), Ltd.
6, Princes-street, London, E.C. 2. 171

Royal State Railways of Siam.

NOTICE.

Sealed TENDERS for the SUPPLY of SUPERSTRUCTURES of STEEL RAILWAY BRIDGES for B.E. 2471 will be received by the SUPERINTENDENT OF STORES, Royal State Railways of Siam, Bangkok, until Fourteen o'clock on February 28th, 1929.

Blank Tender forms, general conditions and specifications can be obtained from Messrs. Sandberg, 40, Grosvenor-gardens, London, S.W. 1, upon payment of £1 10s. per set, which sum will not be refunded.

Right is reserved to reject any or all Tenders. 173

The Madras and Southern MAHRATTA RAILWAY COMPANY, Limited,

invite TENDERS for :—

242 TONS STRUCTURAL STEEL WORK for SMITHY, FORGE and STAMP SHOP, together with ASBESTOS SHEETING, PATENT GLAZING, GALVD. C.I. PIPING, &c. &c.

Tenders are due in on Wednesday, 12th December, 1928, by 10.30 a.m.

Tender form obtainable at address below; fee One Guinea, which is not returnable.

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices :
25, Buckingham Palace-road,
Westminster, S.W. 1. 231

Bombay, Baroda and Central INDIA RAILWAY CO.

PRODUCTION ENGINEER.

REQUIRED for service in the Locomotive and Carriage Shops, broad-gauge system.

PRODUCTION ENGINEER.

Candidates should be between 25 and 35 years of age and preferably unmarried.

QUALIFICATIONS REQUIRED.

(i.) A sound knowledge of modern production methods, with special training in machine shop practice. Must be capable of introducing new production methods in a large engineering works.

(ii.) Must be a good designer of jigs, tools and fixtures, and able to make tool lay-outs for all classes of machine shop work.

(iii.) A sound knowledge of planning and rate fixing. Must be capable of laying out detailed manufacturing operations, estimating times, and detailing the type of machines on which parts are to be manufactured.

(iv.) Must be prepared to supervise demonstrations of operations of all classes of machine tools used in a large machine shop.

(v.) Must possess a good knowledge of inspection methods and gauging systems. This is essential.

(vi.) Locomotive and carriage and wagon experience not essential.

Candidates must possess a good general and technical education and preferably hold a recognised Engineering Degree or Diploma.

TERMS.—A three years' agreement in the first instance, and service may be continued if agreeable to both parties. Free first-class passage to India and home again, in accordance with the Rules and Regulations, &c.

SALARY.—Rupees 550 plus £15 overseas allowance per calendar month.

The selected candidate will be required to pass a strict medical examination before appointment.

Applications (by letter), giving full particulars of general and technical education and honours gained (if any), age and whether married, together with details of training and experience, in chronological order (with dates), and copies only of testimonials, must be addressed to the undersigned not later than 1st December, 1928.

S. G. S. YOUNG,
Secretary.

Offices: The White Mansion,
91, Petty France, Westminster, S.W. 1,
13th November, 1928. 235

Government of Northern IRELAND.

CIVIL ENGINEERING APPOINTMENTS.

APPLICATIONS are INVITED for TEMPORARY POSTS of ASSISTANT CIVIL ENGINEER under the Ministry of Finance. Candidates should have had experience in the calculation and design of dams, weirs, sluices, breakwaters, piers, and harbour works generally.

The duration of the appointments will probably be from six to nine months. Salaries will be fixed in accordance with qualifications and experience.

Applications must be made on the prescribed form, which can be obtained from the SECRETARY, Ministry of Finance (Establishment Division), 15, Donegall-square West, Belfast, and must be returned, with copies ONLY of recent testimonials, so as to reach that office not later than the 7th December, 1928. 172

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED

WANTED, an ENERGETIC MAN, to Take Charge of Sales of a well-known make of Electric Arc Welding Plant and Welding Metals; must have had both Electrical and Metallurgical training.—Write, giving qualifications, experience, &c., to Z.X. 898, care Deacon's Advertising Agency, Fenchurch-avenue, London, E.C. 3. 233 A

WANTED AT ONCE for Africa, MECHANICAL ENGINEER, to Install small Hydro-electric Plant, Petter Oil Engine and Alternator, and Motor-driven Air Compressor, and Supervise Construction Riveted Steel Pipe Line. Site is healthy and at 6000ft. elevation. Probable length of engagement, 12 months. Applications invited only from thoroughly competent reliable engineer with first-class references and good health.—Reply to PAULING and CO., Ltd., 26, Victoria-street, S.W. 194 A

WANTED for Large Works in Manchester District, a first-class PRODUCTION ENGINEER, under 40; must have held a similar position and be capable of organising production and fixing piece rates; experience of small Lathe and Press Work essential; must be a practical man, able to suggest best methods of manufacture. Liberal salary offered to first-class man.—Address, with copies of references and stating age, 189, The Engineer Office. 189 A

FIRST-CLASS STRUCTURAL DESIGNER (Manchester district); used to keen competitive designs. Good prospects.—Address full particulars to 192, The Engineer Office. 192 A

SITUATIONS OPEN (continued)

WANTED, Young ENGINEER, Preferably with university training and degree, who has specialised in modern boiler practice and combustion engineering, for the purpose of being trained to take position on the sales organisation.—Reply, giving full particulars of education, experience and age, to SIMON-CARVES Ltd., 20, Mount-street, Manchester. 226 A

ASSISTANT WORKS MANAGER WANTED for Factory in South-East London, employing 300 hands; must be good disciplinarian and have some knowledge of modern Factory Methods. Small salary (£250 to £300) to start with. Might suit ex-Naval Officer.—Address, in first instance, giving full particulars of qualifications, age, experience, &c., P5188, The Engineer Office. P5188 A

JUNIOR ENGINEER, with Drawing-office and workshop experience, WANTED, to Supervise Erection anywhere this country. Must have combustion experience. Salary £23 monthly. State age and previous career.—Address, 119, The Engineer Office. 119 A

LIFT ESTIMATOR REQUIRED by Firm in Midlands; must be able to Conduct Sales Correspondence. State age, salary required and details of experience.—Address, P5196, The Engineer Office. P5196 A

MACHINE SHOP SUPERINTENDENT REQUIRED for large Motor Factory in the Midlands. Applicants must possess an exhaustive knowledge of the most modern methods of production and be conversant with the latest Machine Tool Practice.—Full particulars, including experience, qualifications, age and salary required, to be posted to Box W. 21312, Haddon's, Salisbury-square, London, E.C. 4. 168 A

NEW Big Chemical/Technical Industry Wants TECHNICAL WORKS MANAGER, having been in similar position with large factory. First-class position with good prospects. Age not above 45.—Address, P5209, The Engineer Office. P5209 A

PRODUCTION ENGINEER REQUIRED in Westminster; accustomed to Ordering and Estimating Mechanical Equipment. Metallurgical and Electrical Office Experience advantageous. Age 25-35. State experience and salary required.—ELECTRIC FURNACE COMPANY, 17, Victoria-street. 204 A

REPRESENTATIVE, with Technical and Sales Experience, and able to estimate and quote for work, REQUIRED by old-established firm of Iron and Brass Founders.—Address, in confidence, stating age, experience and salary required, &c., P5199, The Engineer Office. P5199 A

REQUIRED AT ONCE.—ASSISTANT to PURCHASING AGENT for large company; must have good general engineering knowledge combined with commercial experience; knowledge of Bookkeeping an advantage, but not essential; age 23-25.—Apply by letter, with copies of testimonials and full particulars of experience and salary required, 246, The Engineer Office. 246 A

REQUIRED, an ELECTRICAL and MECHANICAL ENGINEER of considerable technical and practical experience, to Assist Managing Director; must be first-class Designer and Draughtsman; 35 to 40 years of age. Send full details of technical training, practical experience and salary required.—Address, 205, The Engineer Office. 205 A

REQUIRED, FOUR First-class STRESS-MEN, with experience of Detail Stressing and Air Ministry requirements.—State age, experience and salary required to the BLACKBURN AEROPLANE and MOTOR CO., Ltd., Brough, E. Yorks. 175 A

SEVERAL TEMPORARY ASSISTANTS REQUIRED by a Consulting Engineer in Glasgow; must be trained Engineers, with experience in Steam and Heating Installations, and have good knowledge of values of different kinds of plant. Applicants must state experience and salary required.—Address, "STEAM," Wm. Porteous and Co., Advertising Agents, Glasgow. P5194 A

THE SCIENCE OF MEASUREMENT APPLIED TO INDUSTRY OFFERS PROFESSIONAL CAREER to AMBITIOUS and INTELLIGENT YOUNG MAN. Extensive possibilities, laboratory and commercial. Investment. Highest references.—Write, Box 993, Sells' Advertising Offices, Fleet-street, E.C. 4. 193 A

THOS. FIRTH and SONS, Ltd., have a VACANCY for an experienced practical PRODUCTION ENGINEER, who can immediately carry the responsibility for the Planning and Progress of Work in their Machine Shops, particularly in connection with their Heavy Machine Shops engaged on Marine and General Engineering Work. Practical experience with that class of work and planning in absolutely essential. Applicants should state age, fullest details of experience and training, education, and salary required. Good prospects for the right man. Applications will be treated confidentially. Copies of testimonials re practical and planning experience should be submitted.—Address to "M.," Secretary, Norfolk Works, Sheffield. 185 A

WANTED AT ONCE, TWO Good GENERAL SENIOR DRAUGHTSMEN, preferably with modern Cement Works experience.—Address, 124, The Engineer Office, giving full details of experience and copies of references. 124 A

WANTED by Well-known Engineering Firm in Midlands, a capable SENIOR DRAUGHTSMAN of wide experience in the Design and Detailing of Elevators and Conveyors for Handling Materials of all descriptions, and accustomed also to Structural Steelwork and general Mechanical Work.—Address, stating age, experience, salary expected and give references, 214, The Engineer Office. 214 A

WANTED, CHIEF DRAUGHTSMAN for Modern Design of Steam and Electrical Winders, Haulages, &c.—Address, 240, The Engineer Office. 240 A

WANTED, CHIEF DRAUGHTSMAN, Thoroughly accustomed Hydraulic Press Trade. Prospect of interest for the right man.—Address in confidence, giving age, experience, and wages expected, P5156, The Engineer Office. P5156 A

WANTED, First-class CARRIAGE and WAGON DRAUGHTSMEN, experienced men only.—Apply, giving full particulars of experience, salary required, &c., to the BIRMINGHAM RAILWAY CARRIAGE and WAGON CO., Ltd., Smethwick. 211 A

WANTED for London Drawing-office, an ENGINEERING DRAUGHTSMAN, one with experience in Structural Steelwork preferred.—Address, stating, age, experience and salary required, 196, The Engineer Office. 196 A

WANTED for London Drawing-office, a JUNIOR, age about 17.—Address, giving full particulars, including age and salary required, 197, The Engineer Office. 197 A

WANTED for London Office, TWO or THREE DETAILING DRAUGHTSMEN, accustomed to Detailing Steel-framed Buildings. State, age, experience and salary required.—Address, 201, The Engineer Office. 201 A

DESIGNER - DRAUGHTSMAN, First - class, WANTED, thoroughly experienced in Textile Machinery Design; preference will be given to man conversant with Hackling Machines. State salary and when at liberty.—Address, 210, The Engineer Office. 210 A

DRAUGHTSMAN (Engineer), Accustomed to Design and General Lay-out of Pumping Machinery and Auxiliary Plant, Estimating, &c.—Address, stating age, experience, and salary required, 9672, The Engineer Office. 9672 A

DRAUGHTSMAN, Experience in Steel-frame Buildings.—Full particulars of training, age and salary expected to DRAUGHTSMAN, Artex Ltd., Slough. 228 A

SITUATIONS OPEN (continued)

DRAUGHTSMAN REQUIRED for Small High-grade Electrical Instrument Firm.—Address, stating experience and salary required, 213, The Engineer Office. 213 A

DRAUGHTSMAN REQUIRED, Preferably About 35 years of age, and having had experience on Small Ships, Aircraft and Electrical Work. State full details and mention wages required.—Address, 176, The Engineer Office. 176 A

GENERAL TRACER, Smart Junior, REQUIRED, London; also to assist in office work.—Address full particulars to 179, The Engineer Office. 179 A

JIG and TOOL DRAUGHTSMAN WANTED IMMEDIATELY, experienced in the Design of Press Tools for Sheet Metal Work; must be an accurate and reliable worker.—Apply in writing, stating age, experience, salary required and when available, to the BRITISH THOMSON-HOUSTON CO., Ltd., Fittings Factory, Lower Hillmorton-road, Rugby. 200 A

JUNIOR DRAUGHTSMAN (Temporary, possible permanency), Buildings, Lay-outs, &c. Address, P5182, The Engineer Office. P5182 A

REQUIRED, ENGINEERING DRAUGHTSMAN, used to Electrical, Steam and Hydraulic Plant Lay-outs; must be rapid and accurate calculator. Progressive position to right man. State age, training, past experience and salary required.—Address, P5193, The Engineer Office. P5193 A

REQUIRED for South America, SURVEYORS or DRAUGHTSMEN, experienced in Field Revision Work and Map Drawing.—Send references, state age, experience and salary required to Box No. 37, c.o. White's, 72-78, Fleet-street, E.C. 4. 186 A

REQUIRED, SIX First-class AERONAUTICAL DRAUGHTSMEN, with good experience on All-metal Construction, &c.—State age, experience, and salary required to the BLACKBURN AEROPLANE and MOTOR CO., Ltd., Brough, E. Yorks. 174 A

WANTED, FOREMAN, with Boiler Shop Experience, capable of Handling all classes of Riveted and Welded Steel Vessels; must be capable of Estimating Costs; district, Leicestershire.—Address, P5197, The Engineer Office. P5197 A

EXTENSION of Large Works in London Manufacturing Steel Tanks, Riveted and Welded Structural Work, Chemical Plant, Pressure Vessels, Hydraulic Pressings, &c., REQUIRE the SERVICES of WORKS FOREMAN accustomed to Template Making, Plating, Piecework rates. Also TEMPLATE MAKER, SENIOR DRAUGHTSMAN and SENIOR ESTIMATOR.—Applications, stating fullest particulars and experience in confidence to Box 985, Sells' Advertising Offices, Fleet-street, E.C. 4. 232 A

MAINTENANCE FOREMAN (MECHANICAL) REQUIRED for works in Newport, Mon.; must be experienced in upkeep and repair of Rolling Mill Plant, Steam, Hydraulic and Pneumatic Power Plant, Machine Tools, &c.—Address, in first instance, giving full particulars of experience, age, present occupation and earliest date could commence, 206, The Engineer Office. 206 A

SECTIONAL MACHINE SHOP FOREMAN.—REQUIRED, the SERVICES of a thoroughly experienced SECTIONAL MACHINE SHOP FOREMAN in a modern Engineering Works in the Midlands, engaged on medium and heavy type Crane Work. Must have had at least 5 years' experience in a thoroughly modern plant and be practically acquainted with the latest types of labour-saving machinery, including Gear-cutting Machines. A sound progressive job for the right man.—Address, P5150, The Engineer Office. P5150 A

SITUATIONS WANTED

AN ENGINEER, Fully Qualified, of Proved Inventive ability, offers his SERVICES (part or whole time). Experienced Technical Adviser; thoroughly efficient Designer; used to intricate automatic machines, &c. Competent to develop schemes. Highly successful record; held important posts. Wide and varied experience. Has made several valuable inventions. First-class Diplomas; first-class B. of T. Cert.; M.I.N.A., &c. Fluent French; age 40. Highest references.—Address, P5173, The Engineer Office. P5173 B

AN OPPORTUNITY OCCURS for Firm Requiring fully qualified ENGINEER with thorough commercial training to OBTAIN SERVICES of B.Sc. (20), 3 years shops, 1 year D.O., 1 year rate fixing and estimating; last 3½ years up-to-date commercial office, correspondence, sales, advertising, &c.—Address, P5191, The Engineer Office. P5191 B

DEVELOPMENT ENGINEER, Age 28, A.M.I. Mech. E., 6 years machine and fitting shops, 5 years research and development, experience with steam, hydraulic presses and electrical power, DESIRES CHANGE, similar work or Technical Representative.—Address, P5205, The Engineer Office. P5205 B

ENGINEER DESIRES POSITION Abroad. Mechanical, constructional, electrical, internal combustion, machine shop; competent plans, estimates, native labour. Last position 9 years. Excellent references.—SIDDOWN, Sunnyhill, Halton, Leeds. P5162 B

ENGINEER, Extra First Class B.O.T. Certificate (1928), 15 years' sea experience, including refrigeration, 8 years chief engineer, drawing-office, age 36, DESIRES POSITION ashore.—Address, P5180, The Engineer Office. P5180 B

ENGINEER MANAGER, Having Extensive Experience in control, organisation and development of business, home and overseas, sound and varied technical knowledge, DESIRES APPOINTMENT; highest references.—Address, P5119, The Engineer Office. P5119 B

ENGINEER MANAGER, 20 Years' Experience, DESIRES CHANGE. Extensive experience general engineering and commercial vehicle maintenance and organisation.—Address, P5185, The Engineer Office. P5185 B

ENGINEER or MANAGER WANTS PROGRESSIVE POST, 24 years' general engineering experience, thorough knowledge of works organisation, cheapening of production costs, charge of drawing-office.—Address, P5206, The Engineer Office. P5206 B

ENGINEER SEEKS EMPLOYMENT; 30 Years' experience shops, sea, D.O., and inspection work; has electrical knowledge and some commercial experience.—Address, P5183, The Engineer Office. P5183 B

ENGINEERS' TRAVELLER, Many Years' Experience two largest firms agricultural and industrial, DESIRES SIMILAR POSITION or Inside Sales.—Address, P5207, The Engineer Office. P5207 B

ENGINEER (32), 5 Years Locomotive, 11 Years marine, 1st Class B. of T., experience turbines, Diesel, refrigeration, excellent refs., DESIRES RESPONSIBLE POSITION.—Address, P5210, The Engineer Office. P5210 B

ENGINEER (31), 1st Class B.O.T. Certificate, Good general experience and technical education, energetic, ambitious, DESIRES PROGRESSIVE POSITION, home or abroad.—Address, P5187, The Engineer Office. P5187 B

ENGINEER (39), Ex-Lieut.-Commander, R.N., DESIRES CHANGE; good knowledge all classes steam and oil plant, land or marine.—Address, P5177, The Engineer Office. P5177 B

For continuation of Small Advertisements see page 4.

A Seven-Day Journal

British and German Airships.

SUPPLEMENTING his earlier remarks regarding the performance of the Zeppelin airship "Graf Zeppelin" on her recent Transatlantic flights, Dr. Eckener, her designer and commander, in a statement issued to the Press has admitted that as a transoceanic aerial liner the vessel is a failure. For success he stipulates that the engine power should be greater and the speed higher. In addition, the airship should be shorter and of greater diameter. So far as the dimensions of the "Graf Zeppelin's" hull are concerned, it would appear that the long narrow form was dictated by the limitations imposed by the dimensions of the shed in which she was built at Friedrichshafen. The shed dimensions, it is stated by Dr. Eckener, also imposed restrictions on the power plant. It may be recalled that in the case of the ill-fated British airship "R 38" the dimensions of the shed at Cardington, particularly the height available, compelled the designers to place the engine cars farther outboard than many thought desirable from the point of view of safety to the airship structure. The shed has since been enlarged and, so far as we are aware, the "R 101" now being constructed in it has been designed free from any major restrictions imposed by the limitations of the shed accommodation available. It is particularly gratifying to note that, although the new British vessel has a much larger capacity than the "Graf Zeppelin," her length is less and her diameter is greater, two of the modifications which Dr. Eckener considers desirable in any future German airship. We observe that some critics consider Dr. Eckener's remarks as reflecting on the merits of the gaseous fuel used by the "Graf Zeppelin." That is an extension of the German designer's very frank confessions, which nothing that we have seen attributed to him at present warrants. It would be very interesting and exceedingly valuable to have Dr. Eckener's unbiassed views on this aspect of his latest airship. It is known that on her first short experimental trip the vessel was driven by petrol, but the fact that gas was not used was understood to be attributable to some difficulties of an administrative nature raised by the Ministry of Communications. On her Atlantic crossings gas, we understand, was used exclusively. It is not, as some critics seem to imply, a question of the relative merits of gas and petrol as fuel. The use of gas in accordance with the Zeppelin Company's system has, as we have shown on previous occasions, an important effect on the whole operation of the ship, and leads to economies which may well outweigh any extra cost or loss of efficiency by its employment as a fuel.

The Foundering of the Vestris.

DESPITE the earlier hopes which were entertained regarding the safety of the passengers and crew of the Lamport and Holt liner "Vestris," which left New York on Saturday last and foundered some 300 miles off the coast of Norfolk, Virginia, on Monday, November 12th, it is now certain that considerable loss of life has taken place. Several vessels responded immediately to the wireless calls for assistance, but it is evident that some of the lifeboats and a makeshift raft were overturned. As yet mystery surrounds the actual cause of the sinking, and we must await the results of the full investigation which will take place in New York. The owners have, however, stated that the cargo did not include bulk grain. It appears that bad weather was encountered early on Sunday morning, and during the severe storm which continued until Monday heavy seas broke over the vessel, damaging some of the ports and ventilators. According to an official statement, the pitching of the ship caused certain cargo, including motor cars in cases, which was carried in No. 1 compartment above the shelter deck, to break through a bulkhead into the forecastle. This cargo, which fetched up on the starboard side of the ship, was the cause of the heavy list to starboard. The "Vestris" was a passenger and cargo liner of about 10,500 gross tons with a speed of 14½ knots. She was built by Workman, Clark and Co., Ltd., at Belfast in 1912. Her propelling machinery consisted of twin-screw quadruple-expansion steam engines with three double-ended Scotch boilers. Before the "Vestris" sailed from New York she had been dry-docked and her lifeboat equipment surveyed.

Standard Marine Oil Engines.

IN a paper on "Marine Oil Engines," which was read at the last meeting of the Diesel Engine Users Association, and which was published in an abridged form in THE ENGINEER of October 19th, Mr. Sterry B. Freeman, the superintendent engineer of Alfred Holt and Co., Ltd., made the suggestion that some effort should be directed towards the standardisation of the marine oil engine. He said further, that although we were possibly not far enough advanced on the road of oil engine development to crystallise existing practice as fully as the proposal of a standard engine might imply, yet something of the kind was necessary if the full advantage of oil fuel was to be obtained by the shipowner and the competition of steam machinery met. In the last three motor ships which have been ordered for the Blue Funnel Line, Mr. Freeman has advanced in some degree in the direction of the standardisation he outlined. All the engines are to be built to Alfred Holt and Co.'s own specification. A few weeks ago two motor vessels were ordered, one from the Caledon Shipbuilding and Engineering Company, Ltd., of Dundee, with engines by the North-Eastern Marine Engineering Company, Ltd., of Wallsend, and the other from Scotts Shipbuilding and Engineering Company, Ltd., of Greenock, which firm will also supply the engines. It has been recently announced that Messrs. Holts have since ordered a further vessel from Scotts. The principal dimensions of the new motor vessels are—length, 426ft. 6in.; beam, 56ft.; depth, 13ft. 9in.; and 12,800 tons displacement. Twin-screw machinery is to be installed having a total output of 5500 S.H.P. The two engines will be six-cylinder units, operating on the four-stroke single-acting cycle, with exhaust turbo-supercharging. The cylinder diameter is 620 mm., or about 24⅜in., and the stroke 1300 mm., or 4ft. 3⅛ in.

Low-temperature Carbonisation Plant at a South London Gasworks.

THE South Metropolitan Gas Company has for some time past interested itself in the problems connected with the commercial operation of low-temperature carbonisation plants. About a year ago it came to an arrangement with Coal Oil Extraction, Ltd., of Aldwych House, Aldwych, W.C. 2, whereby a K.S.G. low-temperature carbonisation plant of a commercial size should be erected at the gas company's East Greenwich works and operated under the supervision of Coal Oil Extraction, Ltd. Some of the equipment was ordered early in the year, and work on foundations and superstructure was immediately begun. The material already delivered is now in course of erection, and it is expected that the plant will be completed ready for operation in the early part of next year. It has been designed with a view to obtaining a high thermal efficiency throughout, and the hot smokeless fuel discharged from the rotary kiln will be cooled by inert gases in a manner generally similar to that which is employed in the Sulzer dry coke cooling equipment. As further announced at the end of last week, the South Metropolitan Gas Company has also concluded an agreement with Low Temperature Carbonisation, Ltd., whereby it will be enabled to manufacture "Coalite" smokeless fuel under licence at its West Greenwich works. Work is to be begun on a plant capable of carbonising 2000 tons of coal per week, and the general arrangement of the new works will be similar to that of the retorts operating on the British Parker system of low-temperature carbonisation installed at the company's works at Barugh, near Barnsley, in Yorkshire.

The New White Star Liner.

THE statement which was made by Lord Kylsant on his arrival at Southampton on Friday last regarding the definite choice of electric propulsion for the new 60,000-ton White Star liner which is being built at Harland and Wolff's Belfast Yard was perhaps not altogether unexpected. For some time past it has been generally understood that the White Star Line has viewed with particular interest the excellent results which have been obtained with the 21,000-ton Panama Pacific Liner "California." In view of the necessarily large propelling powers called for in the new liner, the good performances of the turbo-electrically propelled United States aircraft carriers "Saratoga" and "Lexington" have been watched with no less interest. Lord Kylsant said that a decision between the rival advantages of turbo-electric propulsion and the generation of the required power by oil engine driven alternators or dynamos had yet to be made. If high-pressure turbo generators be chosen then an installation of the large power required has ample precedent in the machinery of the two naval vessels already referred to, and the notable advances which have recently been made in British marine boiler design and practice. If, on the other hand, oil engine driven generator sets are decided upon a series of high-speed airless injection units may be put forward. Last year a suggestion was advanced to re-engine the liner "Leviathan" with four-cycle double-acting quadruple screw motors of 25,000 S.H.P. The proposed installation included, besides the four twelve-cylinder main propelling engines, six eight-cylinder compressor units and four six-cylinder generator sets. There is no doubt that an all-electric scheme would enable a lighter, smaller and more convenient installation to be worked out. The decision made by the White Star Line is an important one for the British electrical industry, and great interest attaches to the final choice of the generating units.

A Large Electrical Combine.

FURTHER particulars are now available regarding the agreement entered into by the Metropolitan-Vickers Electrical Company, Ltd., with the International General Electric Company of America for the purchase of a controlling interest in three well-known British electrical engineering firms, namely, the British Thomson-Houston Company, Ltd., the Edison Swan Electric Company, Ltd., and Ferguson, Pailin, Ltd. Apart from the financial aspects of the agreement, we note that in view of its enlarged activities, the Metropolitan-Vickers Company is to alter its name—the new style to be adopted has not yet been announced—but in order to preserve goodwill, it is intended to carry on the business through an existing subsidiary under the title of Metro-Vick Electrical Products. The interests brought together in the new organisation will represent the largest combination in Great Britain of firms engaged in the manufacture of electrical plant. The combine will have important works at Trafford Park, Openshaw, Sheffield, Rugby, Coventry, Birmingham, Chesterfield, Willesden, Lutterworth, Ponder's End, and Brimsdown, and will own a number of subsidiary companies trading in various parts of the world. The total number of workpeople employed by the four British companies concerned in the combine on October 1st, 1928, was approximately 29,000. Their combined assets exceed £15,500,000. It is intended that the identities of the four companies shall be preserved, but that there shall be active co-operation between them under the general guidance of a central board. A reduction in manufacturing costs as a result of the economies and co-ordination to be effected under the scheme will, it is hoped, place the company in an improved position to meet foreign competition.

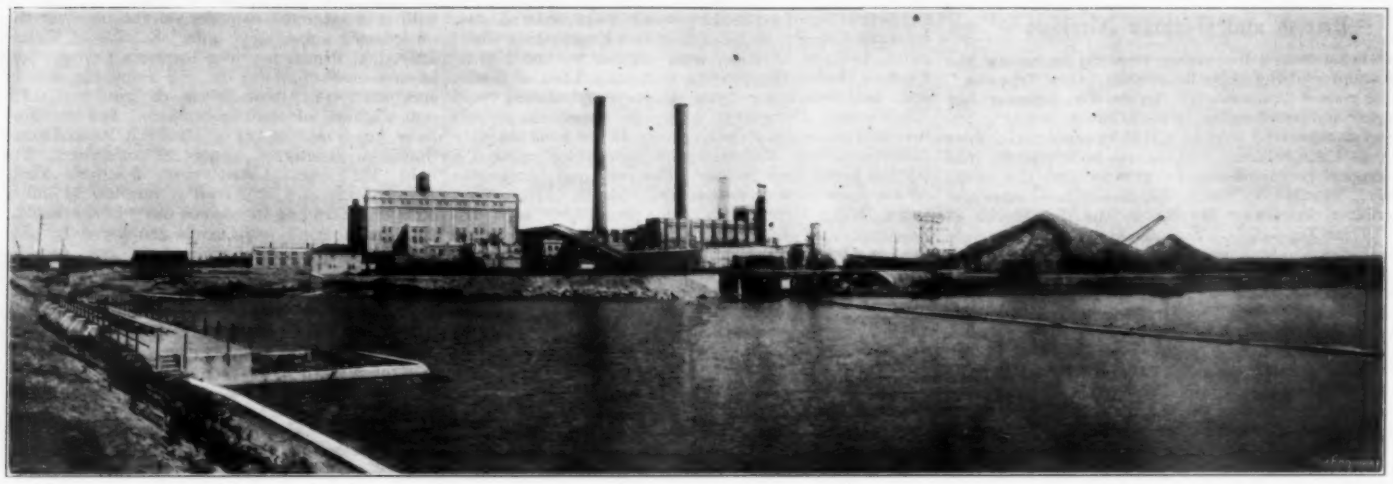
New Hydro-Electric Schemes.

A PROPOSAL to harness the tides in the Wash was explained by Mr. Leonard Weaver and Mr. James Whatnall, a consulting engineer, at a meeting at Hunstanton, which was held on Saturday last, November 10th. It was stated that there was a minimum fall in tide of 17ft. twice daily at Hunstanton which it was proposed to utilise for the generation of electric power by water turbines. The scheme put forward, which is subject to an actual survey yet to be made, is to construct an embankment running out to sea in a north-westerly direction and sweeping round to the south and west to rejoin the coast of the Wash. The proposed embankment would begin at Gore Point, Holme, to the east of Hunstanton, and rejoin the coast line at Snettisham, some 6 miles to the south-west of the town. Some 35,000 acres of water would be enclosed, and it has been estimated that by impounding the waters in this area the level of the water within the embankment would not fall more than 2ft. below the ordinary high tide level. The seaside resort of Hunstanton would thus benefit by the practically permanent full tide thus created, and a safe yachting base might be developed. On the suggestion of Lord Fermoy, who presided at the meeting, the proposal will be brought before the Hunstanton Urban District Council. Another hydro-electric scheme has recently been worked out and a syndicate formed to develop the water power resources of the Galloway district in the south-west of Scotland. The waters of the river Dee and its tributaries, together with those of Loch Doon and other lochs, are, it is proposed, to be harnessed by the building of dams and reservoirs, tunnelling where necessary, and raising the level of some of the lochs. The scheme embraces five power stations, and, if carried out, would come under the control of the Central Electricity Board.

New Admiralty Contracts.

THE Admiralty, it is understood, will shortly be inviting tenders for the seventeen vessels which are to be built by contract under the current Navy Estimates. They comprise one flotilla leader, eight destroyers, one river gunboat, two sloops, and five submarines. The remaining ships of this year's programme are to be built in the dockyards, an 8400-ton cruiser and two sloops at Devonport, an 8400-ton cruiser at Portsmouth, and a submarine and a submarine depôt ship at Chatham. Owing to the scarcity of commercial orders, competition for the Admiralty contracts promises to be very keen, despite the notoriously small margin of profit which work of this nature leaves to the builders. It is of interest to note that the five-year building programme approved by Parliament in 1925 will expire in 1929–30. Since being introduced it has undergone amendment, in that three cruisers have been dropped—two of 10,000 and one of 8400 tons—while mine-sweeping sloops have replaced the coastal motor boats first projected. On February 15th last Mr. Bridgeman gave a promise in Parliament that all the remaining vessels of the programme would be duly laid down in the years to which they were assigned. Next year's batch, which will be the last, should therefore include three cruisers, an aircraft carrier, nine destroyers, six submarines, and a net-laying vessel. It is possible, of course, that political developments taking place in the interval may lead to some further modification of our shipbuilding policy. If, however, the five-year programme, as already amended, should be carried out without further deletions, it will eventually give us the following new ships:—Seven 10,000-ton and six 8400-ton cruisers, one aircraft carrier, three flotilla leaders, twenty-four destroyers, twenty-four submarines, six sloops, five river gunboats, two submarine depôt ships, one repair ship, one net-layer, and a floating dock. The total cost of the programme was originally estimated at £58,000,000, but this figure must have been substantially reduced by the cancelling of three cruisers.

PAPER MILL AT KAPUSKASING, NORTHERN ONTARIO



PANORAMIC VIEW OF PULP AND PAPER PLANTS

Spruce Falls Paper Mill and Power Plant in Northern Ontario.

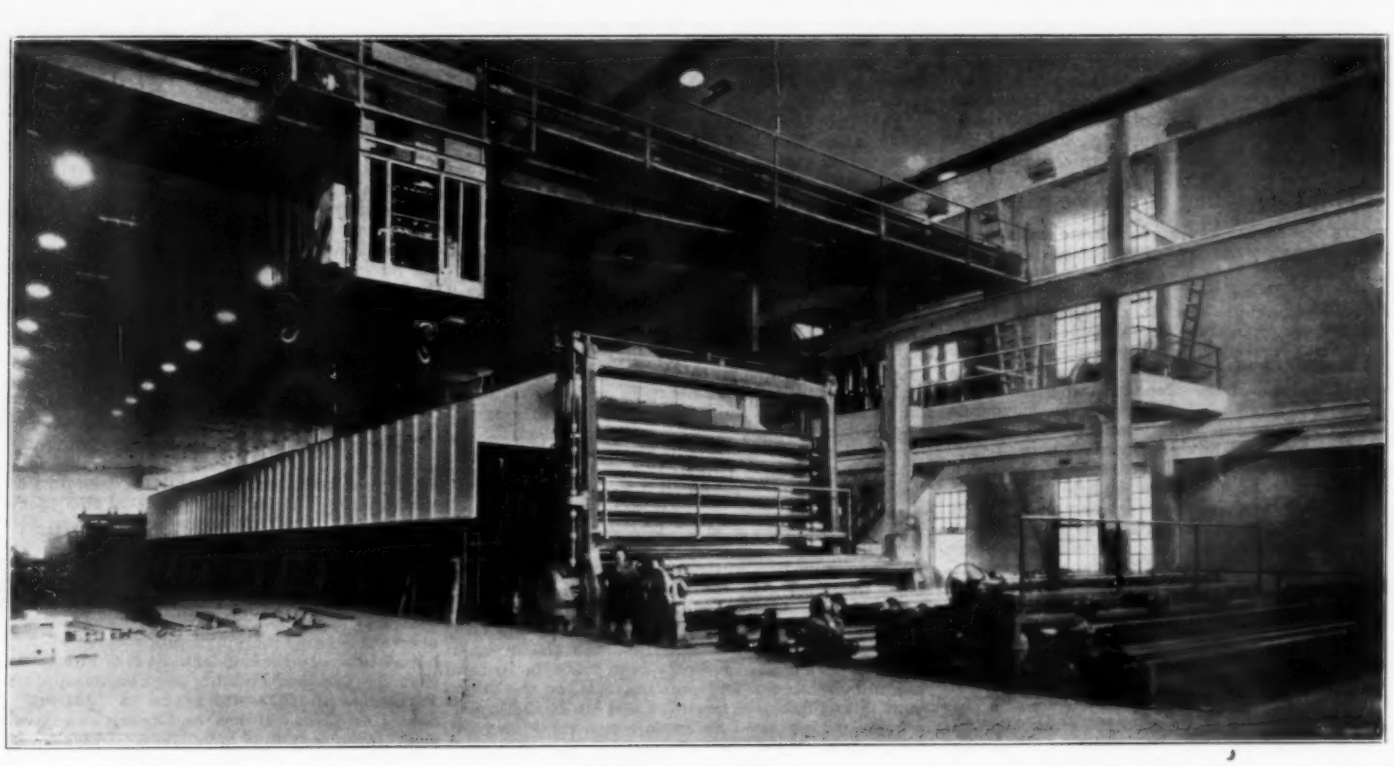
An important achievement of recent years in Northern Ontario is the founding of the extensive new enterprise of the Spruce Falls Power and Paper Company, comprising a pulp and paper mill at Kapuskasing, which has a combined capacity of 600 tons daily; a hydro-electric development of 75,000 horse-power at Smoky Falls, on the Mattagami River; and 50 miles of transmission line; the whole being linked to the Canadian National Railway system by 50 miles of standard gauge railway.

Prior to the formation of the company a 100-ton sulphite mill had been in operation at Kapuskasing for some years. The new company, which is controlled by the *New York Times* and the Kimberley-Clarke Company, is spending approximately 40 million dollars on the project, on which work was actively commenced in 1926. The capacity of the sulphite mill has been increased to 230 tons per day, and a large groundwood mill is practically completed. A newsprint mill, which will have a capacity of 550 tons per day, is already in operation, and power is being delivered from the new plant at Smoky Falls.

The building of the standard gauge railway was necessary to facilitate the large-scale power development at Smoky Falls, which included the construction of a main barrage 1700ft. long, with a maximum height of 100ft. and excavation work that is among the most notable of the rock cuts on the North American Continent. By means of the barrage, the natural head of 86ft. was increased to 114ft. Construction work at the power station and along the railway road bed, which had to be built through a country devoid of wagon roads or water passages, was facilitated by a 2500 H.P. development at Kapuskasing. This small power-house will serve, in the future, as an auxiliary and for emergencies. The railway passes through some of the most rugged country in the north, and construction difficulties were frequent. It was necessary to cache large quantities of supplies taken in on a winter road in February, 1926, and by that means the road bed was completed and foundations laid for the transmission towers by November of the same year. The work done during 1927 and 1928 has been on the power barrage, power-house, turbines, and paper mill. The structures at Smoky Falls are all of solid concrete. In the main barrage ten 40ft. Stoney sluice gates are provided to take care of the spring run-off. When completed, the main power-house will contain four units of 18,750 H.P. each.

The Mattagami River with its main tributaries, the Kapuskasing and Ground Hog rivers, drains an area of about 12,000 square miles, and has a minimum flow of approximately 7000 cusecs, with a maximum of 120,000 cusecs. The natural formation at Smoky Falls made an ideal site for a power development. An island divides the river into a natural gorge that is almost a ready-made tail race, and a wide and comparatively shallow series of rapids. The banks of the river are sufficiently high to give a large water storage, and the natural fall thus easily increased to 114ft., gives a fine head of water at the turbines. Rock of excellent quality and in sufficient quantity for the whole job of building the barrage and power-house was taken out of the gorge during the excavations for the foundations and the tail race. A steel flume, 17ft. in diameter, brings the water from the forebay at the head of the gorge to the power-house below.

The penstocks, butterfly valves and hydraulic turbines, complete with their governors, were supplied by the Canadian Allis-Chalmers, Ltd.; while the Canadian General Electric Company had the contract for the generators, transformers, &c. The four penstocks in this development are each 17ft. diameter at the upstream end, tapering to 14ft. at the connection to the butterfly valve. The company also supplied a plate steel dished head arranged for closing the downstream end of one penstock, including all necessary field rivets. There are three butterfly valves, each 14ft. diameter, mounted on horizontal shafts, and complete with cast steel wickets and housings.



PAPER MACHINE NO. 1

The towers for the 50-mile transmission line between rubber seal rings and hand and motor-operating mechanism. At present there are three main turbines with provision for a fourth unit. They are vertical plate steel spiral-cased turbines, having cast steel speed rings, plate steel draught tube liners, with inspection manhole and cast iron and plate steel pit liners.

The governing mechanism consists of three Allis-Chalmers oil-pressure governors with belt-driven fly balls, each unit having a motor-driven pump of a capacity sufficient for controlling two units, complete with pressure and receiving tanks, and interconnected piping system. Servo-motors are mounted in the cast iron sections of the pit liners. A feature of the butterfly valves is that they have rubber sealing rings in the housing, which is inflated with air when the valve is in a closed position, and makes, it is said, a perfect seal.

Kapuskasing and Smoky Falls, which are 80ft. high, are spaced 800ft. apart, and carry two aluminium circuits for transmission at 110,000 volts.

An idea may be gained of the scope of the pulp and paper phase of this enterprise by the fact that the list of structures at Kapuskasing number thirty-three. They include the following:—Sorting booms, drum barkers, acid tanks, sulphur burners, acid plant, blow pits, dry machine room, locomotive house, repair shop, store houses, grinder room, paper machine room, train shed, turbine room, coal storage, sub-station, water tank, hot pond, wood room, lime slacking, digester building, wet machine room, pulp storage and shipping room, blacksmith shop, screen room, mixing room, finishing room, roll grinder room, boiler room, bunkers, and pump house.

The Spruce Falls Company had been operating four digesters for the manufacture of unbleached sulphite pulp for several years, and shipping the product to the associated companies at Neenah, Wisconsin. It was the intention and plan of the company when the mill at Kapuskasing was first projected that there should eventually be an extension of the plant to include groundwood and newsprint departments as well. Instead of merely adding these departments to the original sulphite mill, it was decided to install four additional digesters. To accomplish this extension, the digester house was doubled, and, at the same time, the top storey of the old mill was rebuilt, so that the reinforced concrete chip bin could run the full length of the building.

The enlarged digester house contains eight digesters

GENERAL VIEW OF THE PAPER MILL

built by the William Inglis Company, with a capacity of about 30 tons each per day. The Paulson acid system, which operates on the milk of lime principle, is adjacent to the digester building, as are also the sulphur burning plant and coolers. A considerable addition was also required for the screen room, which has been made sufficiently large to accommodate the screen equipment preliminary to the making of the pulp for use in the newsprint mill. An interesting feature of the screening department is the use of a 14in. Naylor, spiral-seam copper pipe for conveying the sulphite pulp, and thus taking one more step in maintaining the high quality of the product. The engine shed will accommodate four locomotives.

The paper mill, which adjoins the new screen room, contains four 234in. newsprint machines of the latest design, made by the Dominion Engineering Works, and driven by Harland sectional electric drives. These machines are, we understand, the first newsprint machines designed to run without deckle straps.

The pulpwood reserves controlled by the company are said to contain over 10 million cords, which ensures a supply for at least thirty years. Also, the water powers leased by the company are capable of development to about 140,000 horse-power.

A series of views of the paper mill and of the power station is given herewith and in our Supplement.

The Indian Monsoons of 1927.

By REGINALD RYVES, Assoc. M. Inst. C.E.

As in previous years, the basis of the present review is provided by the monthly supplements to the Indian Daily Weather Reports and the Monsoon Rainfall summary, the latter relating only to the South-West Monsoon.

The South-West Monsoon.

The progress of the monsoon of 1927 was on the whole fairly normal, and well distributed rain fell over most of the country.

June.—The advance of the Arabian Sea Monsoon was established in Malabar on May 27th, and by June 11th rainfall had extended to Gujerat, the Deccan and the Central Provinces. It was fairly active in the peninsular, but weak over most of north-west and central India. The monsoon was established in the Bay of Bengal during the last week of May and extended into north-east India by the first week of June. A strengthening of the Bay current over north-east India between the 16th and 20th brought wide-spread rains to the central parts of the country. It was, however, generally feeble over its field from Burma to the United Provinces, except in Assam. Averaged over the plains of India, the rainfall was in defect by 1·41in., or 16 per cent. The largest defects were in the tract from Bihar and Orissa to the North-West Frontier, including Central India, but not Gujerat. Rainfalls were in defect by 2in. or more in the divisions and by percentages—Burma, 29; Bengal, 15; Bihar and Orissa, 44; Central India, 62; United Provinces, 54; in the sub-divisions: Chota Nagpur, 65; Mysore, 42. They were in excess by 2in. or more in the divisions and by percentages—Assam, 22; Hyderabad, 50; in the sub-divisions: Gujerat, 27; Berar, 39; Madras Deccan, 39; Madras Coast, North, 67; though in Madras as a whole only 16.

July.—Both branches of the monsoon were normally active. The month began with an active monsoon over the peninsular, extending further into Sind and Rajputana by the 7th. The Bay current reached the east Punjab by the 4th, and remained active over north-east India till the 10th. Except for local effects by depressions, it remained weak until the 19th, after which it was active for the remainder of the month. Very heavy rains in Gujerat caused severe floods. Averaged over the plains of India, the rainfall was in excess by 1·45in., or 12 per cent. Expressed as percentages, differences of more than 3in. from the normal rainfalls were, in defect, in divisions: none exceeding 1·72in.; in a sub-division, Konkan, 13. In excess, in divisions: Assam, 20; Bihar and Orissa, 24; Sind, 150—5·57in., the normal being 2·23in.—Bombay, 27; Central Provinces, 25. In sub-divisions: Orissa, 44; Gujerat, 126; Malabar, 28.

August.—The Arabian Sea Monsoon was, in general, weak over the peninsular, but, under the influence of Bay depressions, extended into central parts of the country and north-west India. Depressions which formed at the head of the Bay caused widespread and heavy rains; from the Ganjam coast to the west United Provinces between the 7th and 17th; from Orissa, through the United Provinces to upper Sind, between the 16th and 21st; from Orissa to the United Provinces, from the 21st to the 27th. The Bay current was normally active over Burma, but somewhat weak over north-east India. Averaged over the plains of India, the rainfall was in defect by 0·72in., or 7 per cent. In percentages, differences of more than 2in. from normal rainfalls were:—In defect, in divisions: Bengal, 28; Bihar and Orissa, 15; Bombay, 43; Hyderabad (2·21in.), 35; Mysore (2·25in.), 58. In sub-divisions: Bihar, 29; Gujerat (2·54in.), 44; Berar, 76; Central Provinces, West, 30; Konkan, 36; Malabar, 29. In excess, in divisions: United Provinces, 17; Rajputana, 61; Central India, 23. In sub-divisions: United Provinces, East, 32; Rajputana, West, 90; Central India, West, 41; Central Provinces, East, 35; Madras Coast, North, 48.

September.—From the beginning of the month the Arabian Sea Monsoon was generally weak, and weather was dry in the peninsular until the 10th. Thereafter the monsoon became fairly active. A strengthening, which began on the 26th, extended through Rajputana into the United Provinces, the Punjab, and Kashmir, finally reaching the North-West Frontier Province. This "burst" usually occurs about the 15th and is of considerable value to the farmers. The activity of the Bay Monsoon was directed largely to Upper Burma, Assam and Bengal. Averaged over the plains of India, the month's rainfall was in defect by 0·91in., or 12 per cent. In percentages, differences of more than 2in. from the normal rainfalls were:—In defect, in divisions: Burma, 30; Bihar and Orissa, 26; Central India, 38; Central Provinces, 44. In sub-divisions, significant cases only: Central India, East, 56; Central Provinces, West, 63; Hyderabad, North, 38. In excess, in divisions: Assam, 84; Bengal, 39. In sub-divisions: Malabar, 80, the fall being 14·10in., comparing with the normal of 7·82in. There were very heavy local falls during the month.

In relation to the normal rainfalls, the largest differences were:—In excess, divisions: Sind, 1·2in., or 40 per cent.; Assam, 18·2in., or 30 per cent. Sub-divisions: Gujerat, 10·2in., or 46 per cent.; Madras Coast, North, 7·4in., or 33 per cent.; Rajputana, West, 29. In defect, divisions: North-West Frontier Province, 2·2in., or 44 per cent.; Punjab, 3·7in., or 24 per cent. In sub-divisions: Punjab, South-West, 2·9in., or 35 per cent.; Bihar, 11·6in., or 26 per cent.; the Bay Islands, 23·0in., or 33 per cent. Elsewhere the rainfalls were within 25 per cent. of the normal. Averaged over the plains of India, the season's rainfall was in defect by 1·6in., or 4 per cent. The monsoon seems to have been one of contrasts; record floods having occurred in some regions and shortage, verging on drought, in others. In the grain-growing regions of the Punjab, the United Provinces and the North-West Frontier Province, the most important rain is that of September, which matures the Kharif crops and enables the sowings of Rabi crops to take place. In the Punjab the defect of nearly 2in., or 71 per cent., in that month was therefore serious. In the other two provinces the defects did not exceed 16 per cent. In those three provinces, October is usually nearly rainless, and November practically so, but last year the Punjab received a small excess of 0·35in. in October. The Persian Gulf, or Christmas, rains usually arrive between December 15th and January 15th. Last year the Punjab received an excess of 0·61in. in December and the North-West Frontier Province 0·64in.

The North-East Monsoon.

With regard to conditions precedent to the North-East Monsoon, it may be noted that the mid-July rains, which start the rice crops in Madras and Bengal are reliable and important. Last year Madras received an excess of 1·3in., or 18 per cent., in July, Bengal being in defect by only 10 per cent. Both provinces also rely upon the rains of the end of September for the maturing of the rice crops. Last year there were good September rains—in the Deccan, 21st to 23rd; along the Madras coast, 24th to 26th; over north-east India and Burma, from the 24th onwards. The rainfall of the month was 16 per cent. in excess in Madras, 29 per cent. in Mysore, 39 per cent. in Bengal. Between October 2nd and 6th rainfall was fairly widespread in north-east India and along the north Madras Coast; also, from the 5th to the 8th, over a region extending from east Central Provinces to east Punjab. There were considerable rains in Burma early in the month and extensive rains between the 8th and 13th.

Excepting some local thunderstorm rains and the beginning of the North-East Monsoon, as noted in following paragraphs, the weather of the month was dry over the country generally from the 22nd onwards. Averaged over the plains of India, the October rainfall was in excess by 0·24in., or 7 per cent. In percentages, differences of more than 2in:—In defect, in divisions: Mysore, 91; Madras, 57. In sub-divisions: Orissa, 41; Malabar, 67. In excess, divisions: Burma, 53; United Provinces, 160 (2·27in.). In sub-divisions: United Provinces, West, 393 (3·54in.); Konkan, 103.

The North-East Monsoon appeared over the Madras coast on October 20th. There were widespread rains on the Orissa and north Madras coasts on the 31st, and scattered falls over Bengal and Upper Burma on the 29th and 30th.

November.—The monsoon strengthened early in the month and there was widespread rain in the south of the peninsular, with heavy falls in south Madras. There was widespread rain over the belt of country from Konkan to the United Provinces, West, on the 11th and 12th, and in Burma from the 15th to the 17th. Four western disturbances were recorded, but they brought hardly any rain.

The normal mean of India rainfall was exceeded by 1·09in., or 72 per cent. In only four of the divisions does the normal rainfall of the month exceed 1·0in. Of those, Burma had 1·48in., or 49 per cent. in excess; Bengal, 1·01in., or 82 per cent. in defect. The rainfall of Mysore was nearly normal and that of Madras 16 per cent. in excess. Of divisions in which the normal falls for the month are very small, the United Provinces received more than four times the normal of 0·24in.; Bombay more than three times the normal of 0·69in.; Central India about twelve times the normal of 0·33in.; the Central Provinces more than four times the normal of 0·55in.; Hyderabad more than four times the normal of 0·81in. Perhaps the most important of the differences in sub-divisions were:—In excess: Madras Deccan, by 2·51in., or

SOME EXPRESS PASSENGER LOCOMOTIVES OF THE NEW YORK CENTRAL

(For description see opposite page)

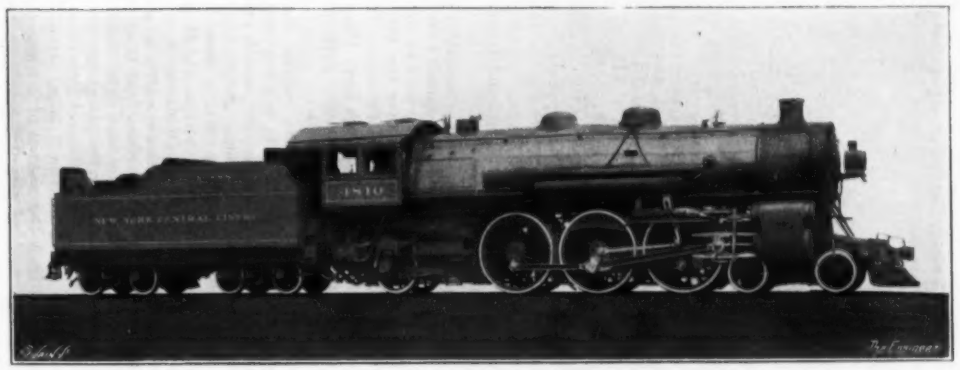


FIG. 1—"PACIFIC" TYPE ENGINE, 1907

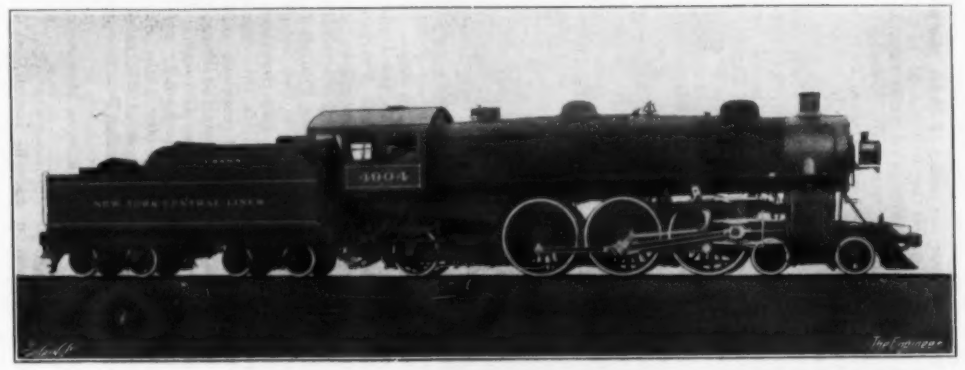


FIG. 2—"PACIFIC" TYPE ENGINE, 1913

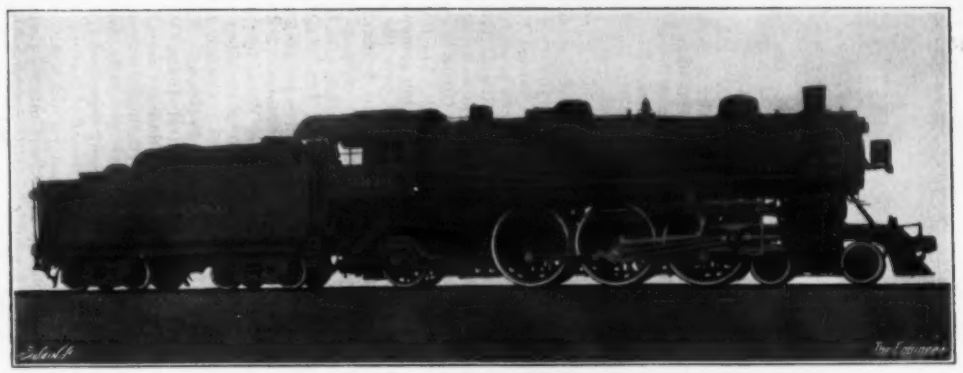


FIG. 3—"PACIFIC" TYPE ENGINE WITH MODIFIED TRAILING TRUCK, 1920

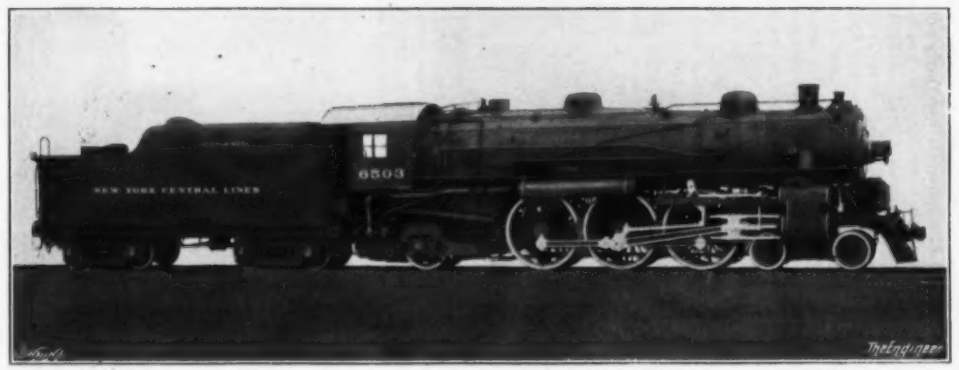


FIG. 4—"PACIFIC" TYPE ENGINE WITH TRAILING TRUCK BOOSTER, 1925

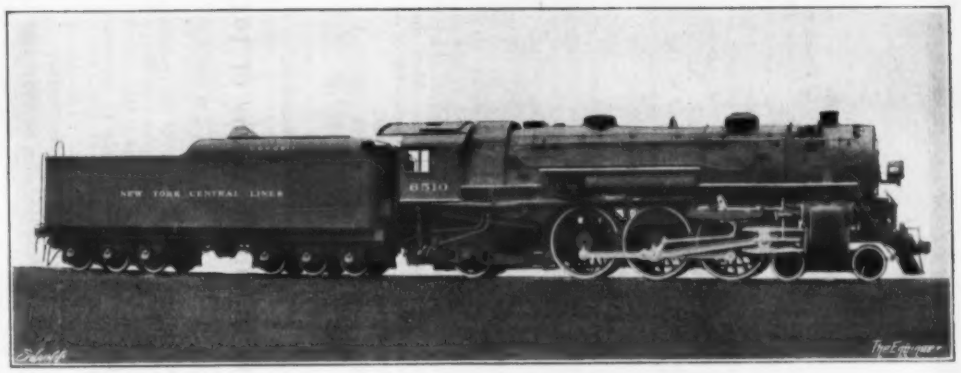


FIG. 5—LATER TYPE "PACIFIC" ENGINE, WITH 12-WHEELED TENDER, 1926

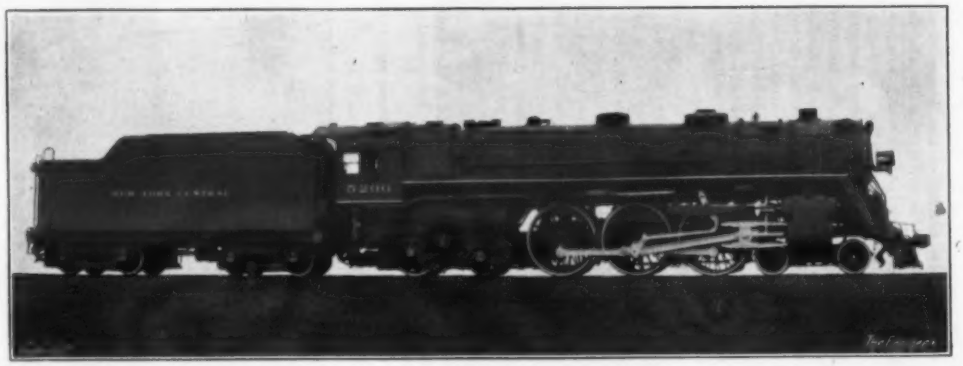


FIG. 6—"HUDSON" TYPE ENGINE, 1927

109 per cent.; Madras Coast, North, by 3·72in., or 66 per cent. In defect: Orissa, by 1·63in., or 90 per cent.

December.—The North-East Monsoon was generally feeble during the month, with revivals in south-east Madras on the 6th and 22nd. The only division in which the normal rainfall exceeds 0·7in. is Madras. In Madras, South-East, where the normal is 4·72in., only 1·74in. was recorded, 63 per cent. in defect; Madras Deccan, normally receiving 0·42in., and Madras Coast, North, 1·23in., were rainless. Of eight western disturbances which came to north-west India, five brought nearly general rains over subdivisions or larger areas, with the result that the month's rainfalls exceeded 1·0in. in Baluchistan, the Punjab, the North-West Frontier Province, and Rajputana, and exceeded 1·6in. in Kashmir and Rajputana, East.

January, 1928.—Comparing with normal rainfalls ranging from 0·21in. to 0·51in., there was no rain in Hyderabad, in Madras, Deccan, nor on the Madras Coast, North. Madras, South-East, received 1·7in., or 0·54 in excess. Elsewhere, in respect only of divisions having normal rainfalls exceeding 1·0in., the United Provinces, West, received 1·85in., an excess of 0·71in.; Punjab, East and North, 1·14in., or 0·38in. in defect Kashmir, 3·75in., an excess of 0·85in.; North-West Frontier Province, 0·49in., or 0·54in. in defect. Other notable figures, relating to divisions in which the normal falls are less than 1·0in., were:—Chota Nagpur, 2·04in., including single-day falls of 1·5in. or more at several stations; Bihar, 1·92in. Averaged over the plains of India the rainfall was 0·45in. or 10 per cent. in defect.

Storms and Floods.

There was widespread and heavy rain near the foot of the hills in north-east India, June 5th to 7th. Falls at individual stations were:—Purnea, 6in.; Maya Dumka, 7in.; Dhubri, 10in., in twenty-four hours. Calcutta was flooded.

A deep depression caused locally heavy rain from south Bengal to Gujerat, July 24th, Saugor Island and Raipur each receiving 7in. In its further progress the depression brought heavy rain to the West Central Provinces and South Rajputana, the rain being exceptionally heavy in Gujerat. At Ahmedabad 46in. fell in five days, 29in. of this being recorded in forty-eight hours and 16in. in twenty-four hours. These rains caused disastrous floods in Gujerat, many lives being lost. The city of Baroda was flooded, villages were under water, many houses collapsed, and all communications broke down, Gujerat and Kathiawar being virtually isolated for several days.

At the end of July a depression developed into a violent storm in the northern half of the Bay. Inland, the storm brought heavy rain, which caused severe floods in parts of Bihar and Orissa.

Between August 9th and 19th continuous and heavy rains caused floods in the river Beas. Villages were under water and lives were lost. Dehra Dun recorded 6in. on the 9th; Simla, 3in. on the 10th and on the 11th; Delhi, 3in. on the 11th; Roorkee, 5in., and Meerut, 7in. on the 10th.

Early in October there was heavy rain in the east United Provinces. There were also floods in the Hardoi district where some villages were washed away.

A remarkable fall of the barometer to 27in., or 2·3in. below normal, was recorded at Nellore during the crossing of the coast by a storm which reached the Bombay Deccan on November 23rd. In a large area of heavy rainfall, Madras had 3in. of rain, Masulipatam, 6in., and Cocanada, 4in., on the 1st; Hyderabad, Deccan, 4in., and Kurnool, 3in., on the 2nd. Madras City and Nellore were badly affected by the storm. In Madras City about twenty persons lost their lives and a part of the city was flooded; in Nellore about 300 persons and 1000 cattle perished. Reports of terrible disasters were received from villages. At Kodavallur fifty persons were killed by a falling building.

A storm which crossed the coast between Ratnagiri and Bombay wrought great havoc to coastal craft and fishing boats, and unprecedented loss of life at sea. Inland the storm did considerable damage to cotton crops.

Some Heavy Local Rainfalls.

Besides those already noted, the following twenty-four-hour rainfalls are worth recording:—

Lower Burma.—Akyab, 8·18in. in July; Victoria Point, 6·95in. in October; Amherst, 6·75in. in October; Kyaukpyu, 9·5in. in November.

Upper Burma.—Mandalay, which is in the dry zone, 4·77in. in October; Myitkyina, 6·51in. in October.

Assam.—Dhubri, 9·76in. in June; and 10·90in. in July.

Bengal.—Jaipaiguri, 6·40in. in June; Chittagong, 10·2in. in September; Mymensingh, 9·69in. in September; Cox's Bazaar, 6·41in. in October.

Orissa.—Hukitala, False Point, 10·75in. in July.

Chota Nagpur.—Hazaribagh, 5·0in. in September.

Bihar.—Purnea, 6·18in. in June; Naya Dumka, 6·73in. in June, and 7·15in. in August.

United Provinces.—Bareilly, 7·08in. in June and 5·72in. in October; Jhensi, 9·43in. in July and 2·45in. in November; Dehra Dun, 5·90in. in July, 7·86in. in August, 7·31in. in September; Cawnpore, 4·30in. in October; Benares, 2·95in. in November; Bahraich, 3·07in. in November.

Punjab.—Sialkot, 4·78in. in August; Ambala, 3·95in. in October; Ludhiana, 1·55in. in December.

Kashmir.—Sonamarg, 1·6in. in December.

Rajputana.—Jodhpur, 7·26in. in August; Kotah, 5·46in. in August and 2·13in. in November; Udiapur, 1·47in. in December.

Berar.—Amraoti, 6·11in. in June.

Central Provinces.—Jagdaipur, 6·16in. in August.

Konkan.—Marmagao, 6·38in. in June; Ratnagiri, 5·77in. in October.

Bombay Deccan.—Bombay, 4·83in. in November.

New York Central—Express Passenger Locomotives.

By E. C. POULTNEY, O.B.E.

No. I.

In this and succeeding articles it is the intention to describe some express locomotives introduced during 1927 for working the most important express passenger trains on the New York Central system, and also to give the results obtained with one of these locomotives during an exhaustive series of trials carried out by the test department of the railway.

In many respects, these new locomotives are of exceptional interest. They provide a striking example of steam locomotive design made necessary by the exceptional duties imposed by modern conditions, and show how the combined requirements of high draw bar pull and speed have been met by the mechanical department of one of the world's foremost railways.

Locomotive Development.

Before, however, dealing with the new engines which have been built by the American Locomotive Company to meet the requirements of Mr. F. H. Hardin, assistant to the president, New York Central Lines, and are known as the "Hudson" type, it is proposed to sketch in broad outline the gradual development of the modern express locomotive on the New York Central which took place during the twenty years' period from 1907 to 1927, when the engines forming the main consideration of these articles were built and placed in traffic.

During this period of time great and far-reaching improvements were made in passenger travel, for the present steel passenger cars hardly bear any resemblance to the old coaches of wood construction, which were largely in evidence in the early years of the present century. As is well known, "all-steel" stock is now the only kind used on the great railways of the United States, and the weight of this equipment, together with the long trains required to meet the demands of travel, are, together with relatively high average speeds, the factors which have made the larger locomotives now in evidence a necessity.

To appreciate the changes that have taken place in engine power on the New York Central, between 1907 and 1927, it is only necessary to state that, comparing the prevailing "Pacific" locomotives of 1907 with the huge "Hudson" type of 1927, there is shown an increase of 33 per cent. in engine weight, in heating surface 53 per cent., in grate area 45 per cent., and in tractive force also 45 per cent., or, if the effort added by the booster now fitted be included, the starting power is greater by no less than 82 per cent. In judging these computations, note must be made of the fact that the engine of 1907 used saturated steam, so that the heating surface values are not strictly comparable.

FIG. 8—MODIFIED "HUDSON" ENGINE

The "Pacific" type passenger engine of 1907 is illustrated by Fig. 1, and so successful were these locomotives that this original design has formed the basis on which all subsequent 4–6–2 engines have been built; thus, the diameter of the drivers has remained standard at 79in., while the driving wheel base was the same up to 1925, and the grate area of 56·3 square feet also remained practically unchanged up to the same time. With the introduction of the flue tube superheater came a change in cylinder dimensions, and engine No. 4904—Fig. 2—shows the design in service about 1913. In general, these locomotives are similar to those originally built in 1907, but by reason of their rather greater cylinder capacity, made possible by the use of superheated steam, the maximum tractive effort was increased from 29,200 lb. to 30,900 lb., and a further noticeable constructional change was the introduction of the Cole trailing truck.

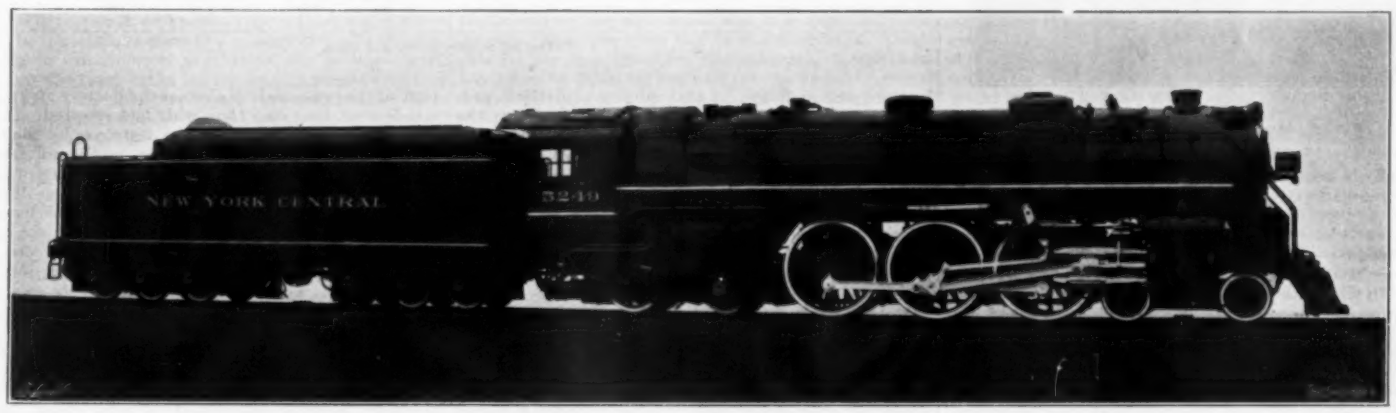


FIG. 7—MODIFIED "HUDSON" ENGINE WITH 12-WHEELED TENDER

As thus modified, engines of this class met requirements up to about 1920, when locomotives of the design illustrated by Fig. 3 were placed in service. Whilst similar in general to the preceding engines these had larger superheaters, and a modified trailing truck, which in this case was of the now well-known Delta type, having cast steel framing. Further, the leading truck wheels were of rolled steel, as now universally used, as against the cast steel spoked pattern having separate tires employed for the previous engines.

Later, a further series of these engines was built,

some of which were fitted with the Franklin trailing truck booster; thus the starting effort was increased by 8000 lb., making the maximum tractive power 38,900 lb. For the locomotives fitted with the booster, the weight was increased by 6000 lb. Subsequently, this same design was again slightly modified, and the booster power augmented so that the maximum starting effort became 40,600 lb., but in other principal features the locomotives were alike. In 1925, however, a further step was taken, and in this instance a change in the cylinder diameter from 23½in.—a size which had remained standard from 1913—to 24in. was made, the maximum tractive effort, engine cylinders only, being thereby increased to 32,200 lb., or, with 9700 lb. provided by the booster, the total tractive effort became 41,900 lb.

Engine No. 6503—Fig. 4—illustrates this design, from which it will be seen that certain detail changes have been made; thus the front end throttle is in evidence, as is also a new kind of connecting-rod, having a solid end, as against the strap form previously employed. A further feature of importance, brought out by the table of dimensions and proportions of these successive locomotive designs, are the weight characteristics. It will be noted that whereas the boiler is of equal size to that fitted to the two immediately preceding locomotives, yet the engine

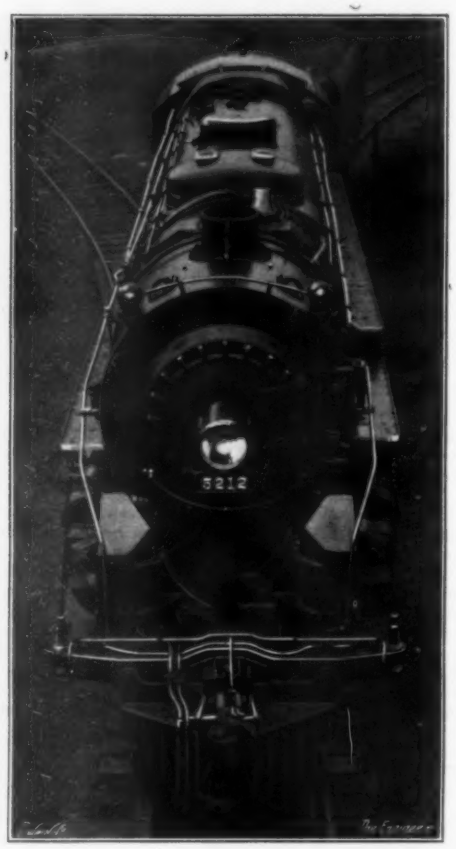


FIG. 9—MODIFIED "HUDSON" ENGINE

weight is less, and that better use is made of that on the coupled axles, as shown by the lower value of the adhesive factor.

Shortly after the introduction of these locomotives it became evident that a considerable increase in power was required to work the heavy express services, and in the same year a new "Pacific" of much larger proportions appeared. These engines reached the limit, both in tractive effort and boiler capacity, because the 184,500 lb. carried by the six coupled axles is the highest possible weight for engines of the 4–6–2 type which may be operated over the various lines composing the New York Central system.

The new "Pacifics" marked a distinct advance on any previously built, both in respect of boiler power and cylinder proportions. The total combined heating surface became 5104 square feet, and the grate area 67·8 square feet, and the cylinders were enlarged in size in respect to diameter and stroke, from 24in. by 26in. to 25in. by 28in., which, with 200 lb. steam pressure and 79in. wheels, gave these engines a rated tractive effort of 37,600 lb. Their equipment included a feed-water heater and front end throttle.

In 1926 this design was modified slightly in certain respects; the principal change, however, was the provision of large twelve-wheeled tenders. The working steam pressure was raised to 205 lb., and that raised the rated tractive effort engine cylinders only, to 38,600 lb., and as the booster contributed a further 9950 lb., the total effort at starting became 48,550 lb.

Up to the introduction of the 4–6–4 "Hudson" type locomotive, these latter "Pacifics," one of which is shown by Fig. 5, were the largest engines so far employed in passenger service, and represented the limit in weight and dimensions permissible on the New York Central system.

The improvements made in the design and construction of these newer engines can probably best be seen by making comparison with the class prevailing in 1920—Fig. 3—which carry the same weight on the coupled wheels, but which had a tractive effort of 30,900 lb. against 38,600 lb. for the new engines, and a total or combined heating surface of 4262 square feet, compared with 5110 square feet. The new engines were also noteworthy for their larger grates, the area of which is 67·8 square feet, representing an increase of 20 per cent. over the 56·6 square feet which had hitherto remained standard.

A further feature which will be noted is the provision of the large twelve-wheeled tenders, having water capacity of 15,000 gallons and space for 16 tons (32,000 lb.) of coal, compared with about 8000 gallons of water and 12 tons of coal for the older locomotives, except the 1925 design—Fig. 4—which had a tender water capacity of 10,800 gallons and fuel space for 16·5 tons.

To complete this brief sketch of the development of the express engines on the New York Central, Fig. 6 illustrates the first "Hudson" type locomotive, No. 5200, photographed at the maker's Schenectady works on February 14th, 1927, when the engine was formally handed over to the railway.

Views of a modification of the type are given in Figs. 7, 8 and 9.

Further notice will not, however, now be given to these locomotives, as the next section of these articles will be devoted to a complete description, but, in conclusion, reference will be made to Table No. I., in which are set out the dimensions of the various locomotives that have received attention.

This table gives the leading particulars of the several locomotives included in this survey and their proportions. A study of these data brings out clearly the trend of modern designing, and in this connection the power increase in relation to weight, both that supported on the drivers and the total, are points worthy of notice. These two features broadly constitute our means of judging the efficiency of design, and if other related ratios bearing on steaming capacity are available, the weight and heating surface ratio indicates how possible power output is related to the engine weight.

TABLE I.—*Dimensions and Proportions of New York Central Express Locomotives.*

Engine type	4–6–2	4–6–2	4–6–2	4–6–2	4–6–2	4–6–2	4–6–4
Date	1907	1913	1920	1923	1925	1926	1927
Cylinders	22 × 26	23½ × 26	23½ × 26	23½ × 26	24 × 26	25 × 28	25 × 28
Driving wheels, diameter, inches	79	79	79	79	79	79	79
Boiler, diameter, inches	72	72	70½	70½	70½	79½	82 7/8
Fire-box, length and width, inches	108 × 75	108½ × 75½	108½ × 75½	108½ × 75½	108½ × 77½	108½ × 90½	130 × 90½
Tubes, number and diameter, inches	380—2	242—2	175—2¼	175—2¼	175—2¼	190—2¼	37—2¼ 19—3½
Flues, number and diameter, inches	—	26—5½	32—5½	32—5½	32—5½	45—5½	182—3½
Length	20–6	21–6	21–6	21–6	21–6	21–0	20–6
Steam pressure	200	200	200	200	200	205	225
Heating surface, square feet—							
Tubes	3960	3553*	2207	2207	2207	2340	800
Flues	—	—	986	986	986	1355	3403
Fire-box	234·4	231·2	231	231	228	257	281
Evaporative, total	4195·0	3784·2	3424	3424	3421	3952	4484
Superheater	—	705·0	838	838	839	1158	1951
Combined	—	4489·2	4262	4262	4260	5110	6435
Grate area	56·3	56·5	56·5	56·5	56·6	67·8	81·5
Wheel base—							
Driving	14–0	14–0	14–0	14–0	13–8	13–8	14–0
Engine	36–6	36–6	36–6	36–6	36–5	36–11	40–4
Weights, lb.—							
On drivers	167,700	173,000	184,500	194,500	169,000	184,500	182,000
Engine	261,000	271,000	282,000	295,500	278,000	297,500	343,000
Tender	164,200	155,300	168,000	168,700	207,000	273,600	212,200
Locomotive	425,200	426,300	450,000	464,200	485,000	571,100	555,200
Rated tractive effort	29,200	30,900	30,900	30,900	32,200	38,600	42,300
Ditto, with booster	—	—	—	40,600	41,900	48,550	53,200
Adhesive factor	5·85	5·60	5·97	6·29	5·24	4·78	4·3
Boiler factor	6·9	6·9	7·25	7·25	7·53	7·54	6·58
Combustion factor	74·5	79·7	75·6	75·3	75·3	75·4	78·9
Design efficiency factor	62·0	60·3	66·0	68·3	65·4	58·1	53·2

* Heating surface tubes and flues.

With these in mind, it is of interest to note that for all the engines given, the heating surface per unit of grate, the combustion factor, is practically unchanged, which would indicate approximately equal steaming capacity per square foot of heating surface. Therefore, the steady fall in engine weight per unit area of heating surface, culminating in the low figure of 53·2 lb. for the modern 4–6–4 engines, indicates continuous improvement in design.

In like manner, the adhesive factor—load on drivers to tractive effort—has been reduced from 6·29 to 4·3, so that the weight available for traction is now utilised to the full, and the boiler capacity in relation to the cylinder power as given by dividing the tractive effort by the total heating surfaces, whilst showing for the "Pacific" type locomotives slight variation indicates the great size of the boilers as applied to the 4–6–4 engines of 1927.

It may here be mentioned that the fire-box heating surfaces given include, in all instances, the area furnished by the arch tubes.

The table of dimensions is not only interesting as indicating the growth in size of these locomotives, but also as showing how certain governing ratios of proportion, once having been found satisfactory, have been maintained with each successive design, and this, with relatively small variation. The illustrations also, while demonstrating at any rate up to 1926 a conservative policy in general design, show at the same time detail changes, and the weight and power characteristics bring out fully an appreciation of the main essential for successful performance.

(To be continued.)

The Salvage of Submarines.

IN March last a sum of 200,000 dollars was voted by Congress to the Bureau of Construction and Repair of the United States Navy Department, "for investigation and experimental work on submarine sofety devices, and the installation in submarines on service of such of these devices as might be considered practicable." This sum was additional to those which had been granted for the usual purposes in the navy appropriations for the financial year which ended on June 30th.

This supplementary amount was voted as a direct consequence of the loss of the United States submarine "S 4," with her officers and men in December last. The circumstances of the accident may be briefly recalled. "S 4," then recently refitted, was undergoing tests off Provincetown, near Cape Cod, and was coming to the surface after a submerged trial run, when she was rammed by the coastal torpedo-boat destroyer "Paulding," a vessel of 740 tons displacement, cruising at 18 knots, the submarine sinking in 100ft. of water, the eventual loss of life being forty, including one civilian, a member of the Inspection Board. The collision occurred on December 17th, the vessel was raised on March 17th and placed in dry dock.

An examination in dock disclosed the fact that the bow of the "Paulding" had penetrated the upper part of the pressure hull abreast the battery space, and a hole 30in. long and 15in. wide had resulted. A keel plate, torn from the bow of the destroyer by the force of the impact, remained in place on the submarine, almost filling the hole, and this to some extent must have diminished the speed of sinking of the ill-fated vessel. The battery space of the submarine is between the fore torpedo compartment and the control room, water-tight bulkheads separating the three compartments. At the time of the collision the doors in the bulkheads were open, but the relatively slow submergence of the submarine enabled an officer and five others to reach the torpedo room, and close and secure the door in the bulkhead. The door in the divisional bulkhead between the battery space and the control room had also been closed, but only partially secured by the clips, and water passed through to the control room. Thirty-four bodies were found in the engine-room, the compartment immediately abaft the control room.

The experts who carried out the examination of the vessel were of the opinion she might have been kept afloat if the ballast tanks, which must have been nearly full of water, had been blown immediately after the collision, an operation which could have been effected from the control room, but the absence of any bodies in that space forced them to the conclusion that noxious gases given off by the electric cables, or more probably by the acid of the battery cells, in contact with the incoming salt water, had driven the officers and men stationed there to the engine-room, before the valves on the blowing system could be manipulated.

The vessels collided late in the afternoon of the 17th, and salvage vessels were immediately ordered to the scene of the accident. The escape of oil and air from the compartments of the submarine indicated her position on the following morning, and in the afternoon divers descended and tapping the hull plating

with hammers, ascertained that all compartments, except the fore torpedo room, were flooded, and obtained signals from the survivors in that space, giving their names and requesting immediate help. On the 19th and 20th heavy seas prevented the divers from descending, but signals from the survivors were received by the listening devices on the surface vessels up to 6 p.m. on the 20th, when they ceased. On the 22nd, the Naval Authorities announced that all hope of saving life had been abandoned.

The fate of the six unfortunate men had been watched by the American public with the most intense and painful interest, the rescue operations and their progress being reported by the newspapers in the greatest detail. It was stated that thousands of suggestions for rescue were received by the Navy Department during those three or four anxious days. As might have been expected in such circumstances the official announcement on the 22nd that all hope of rescue had been abandoned, was followed by severe strictures on the Naval Authorities on their apparent failure, and on what appeared to be the lack of adequate provision to deal with such an emergency. It was claimed that those who were engaged on such extremely dangerous service for the State should be at least guaranteed a reasonable chance of escape in the event of an accident. President Coolidge suggested to the Secretary of the Navy the appointment of a Commission to investigate and report on any practicable measures by which such tragic incidents might be avoided in the future, but, so far as can be ascertained, the Committee was not appointed.

The salvage of submarines sunk in water of a depth of 100ft. is a sufficiently difficult problem, but has been successfully accomplished on several occasions, the most recent being that of the small Italian submarine "F 14." The gradually increasing size of this type of war vessel has added to the difficulties, which are, however, almost insignificant when compared to those involved in the saving of life in similar circumstances. In the latter case time is the vital factor, the operation having to be completed within two or three days, or perhaps less, a period determined only by the endurance of the survivors in the conditions in which they find themselves. There are several instances in which submarines have been forced to the bottom by accidental flooding of the main compartments at one end of the vessel, but the survivors in the intact portion, by blowing the tanks and expelling as much water as practicable from them, have succeeded in raising the unflooded end to the surface, and effected their escape. These mishaps have, however, been in relatively shallow water. The accident to the British submarine "K 13" in January, 1917, whilst on trial in the Gareloch at the mouth of the Clyde, was such an instance, and has been described by Professor P. Hillhouse, D.Sc., who was on board at the time. The depth of water was about 65ft., the after compartments of the submarine being flooded through hatches, which had been inadvertently left open, when the vessel submerged. The closing of a water-tight door restricted the flooding to the spaces abaft the bulkhead at the forward end of the boiler-room, and the survivors, by the use of compressed air, cleared all the forward tanks of water, the fore end became buoyant and very slowly started to rise, pivoting about the after end of the keel, this movement being assisted by hawsers passed under the forepart, and around the capstans of surface vessels. Mechanics from the salvage craft, by cutting a hole in the emerged portion of the pressure hull, enabled the forty-eight survivors of a total of eighty to escape after fifty-five hours' imprisonment. The bow sank again almost immediately, the subsequent salvage operations extending over a period of six weeks. The crew of the U.S. submarine "S 5," which in September, 1920, sustained damage which flooded the forward compartments, succeeded in bringing the stern to the surface by blowing the after tanks, and by drilling a hole in the plating and waving a signal passed through it, attracted the attention of a passing steamer, whose engineers cut a hole through the plating, allowing the imprisoned men to escape. In December, 1921, the sister vessel, "S 48," was damaged aft and the stern compartments being flooded, the vessel sank to the bottom. The crew brought the bow to the surface and effected their escape through the torpedo tubes, which were just above water. In these three submarines, the flooding was partial and at one end of the vessel; the depth of water was relatively small; the control room was intact; and the tank-blowing arrangements being accessible, the clearing of water from the tanks was a comparatively easy task.

When, however, the flooding of the submarine is more complete as in S 4, and the tank blowing system is out of reach of the survivors, the problem of salvage is more difficult, and the saving of life of the survivors is almost hopeless. In August, 1926, the British submarine "H 29," of about 450 tons displacement, was completely flooded by water entering an access hatch which was close to the water, and sank in a basin at Devonport Dockyard, six lives being lost. The submarine was a small one; the depth of water was barely sufficient to cover her upper works; the position at which she sank was alongside the basin wall and was sheltered from wind, tide and sea; and the whole resources of the dockyard were at hand; yet with these favourable conditions it was several days before the vessel was refloated and docked. The United States submarine "S 51," rammed whilst navigating on the surface on September 25th, 1925, sank in 132ft. of water and was raised on July 25th, 1926, the salvage operations being suspended through stress of weather from December 6th to April 26th. The sister vessel, "S 4," lying in 100ft. of water, was raised ninety days after she had been rammed by the "Paulding," the state of the wind and sea being such that diving operations were only possible on forty days of this period.

Captain Ellsburg, who was in charge of the salvage of "S 51" and "S 4," has published an account of the operations on the former vessel, in which he describes the difficulties with which he had to contend. "S 51" had a surface displacement or weight of about 1000 tons, but it was estimated that in her completely flooded condition the weight to be raised was 800 tons. At first an attempt was made to raise the stern by two floating cranes with lifting capacities of 100 and 150 tons respectively, but these, together, failed to move the vessel, and it was decided to use pontoons for the salvage. Eight of these were employed, each having a net lift of 80 tons, the additional 160 tons being obtained by making the submarine partially buoyant by expelling water from some of her compartments. The pontoons were grouped in pairs, the units of each pair being placed on opposite sides of the submarine, and connected together by two chains which passed under the submarine and through two vertical hawse pipes on each pontoon, a stout steel bar through a link of the chain stretching across the top of each hawse pipe transmitting the buoyancy of the pontoons to the chains, and thence to the submarine. The pontoons were fitted with valves for flooding them, and connections for flexible hoses for compressed air from the salvage vessels. When salvage operations were resumed towards the end of April, the submarine had settled 4ft. or 5ft. into the sea bed, and the task of passing the lifting chains under the vessel proved a most troublesome and lengthy one, a tunnel having to be forced through the soil by the divers for each of the eight chains. Difficulty was also experienced in placing the pontoons in the desired positions, but after several unsuccessful attempts, it was found the best method was to detach the chains from the pontoons, reeve them under the submarine and attach steel wire ropes to both ends of each chain. The free ends of the steel wire ropes were then brought to the surface and passed through the hawse pipes of the pontoons. They were held taut and used as guides for the pontoons, which were flooded and eased down to the bottom, the chains finally passing through their hawse pipes. The chains were then adjusted for length, the steel bars passed through the links, and by blowing water the pontoons were given sufficient buoyancy to maintain the chains taut, ready for the final lift, when all the pontoons were completely cleared of the water inside them. This work required some time, the chains fracturing in a few instances, necessitating the repetition of the operations with new and larger chains. The pontoons were found to have insufficient longitudinal stability, and at times when being cleared of water, assumed a vertical instead of the horizontal position, which had to be corrected by reflooding, followed by a more careful and gradual blowing out of the water.

The expulsion of the water from some of the compartments of the submarine was also attended with greater difficulties than had been anticipated. Compressed air was used for the purpose, connections having to be fitted on the hull for the hoses. Several doors, valves, pipes, &c., had to be closed to prevent leakage of the air, and one large valve on the pressure hull of the submarine, which could not be closed, had to be removed, and the opening fitted with a blank flange. The flooding valves to the ballast tanks, which were closed when the vessel was rammed, had to be opened by the divers to allow the water to be removed from these tanks. The greater portion of this work necessitated the divers entering the submarine. The covers to the various access hatches of the vessel, which were completely water-tight when water pressure was applied from outside, were found to leak freely when the excess air pressure necessary to force water out of the compartments was brought on the underside, and they had to be fitted with strongbacks to make them sufficiently air-tight. There were other minor difficulties, which with those already mentioned fully accounted for the ninety days necessary for the salvage. Immediately after the accident thirty naval divers were collected and sent to the salvage craft, but of these ten only were experienced in working in the depth of water—22 fathoms—in which the submarine was lying. During the period in which operations were suspended all the divers were given a course of instruction and training to prepare them for the renewed attempt. Captain Ellsburg stated that in his opinion the salvage of a submarine depends far more upon the skill, courage, and resource of the divers than upon the material.

On the conclusion of the salvage operations on "S 51," Captain Ellsburg forwarded a report to the Navy Department, a copy of which was secured by a member of Congress and published shortly after the "S 4" disaster. In this report he recommended certain additions and modifications to U.S. submarines which he considered would facilitate salvage, should this unfortunately become necessary. He stated that for such a purpose, pontoons were superior to surface craft, as with the latter, indefinite, uneven and probably prohibitive strains would be brought on the lifting chains by the motion of the sea, whereas with pontoons the forces were limited and definite in amount. The most important of his recommendations was the fitting of eye-plates to the submarines, to which the lifting chains could be shackled by divers, thus obviating the time and labour in passing the chains under the hull, as in "S 51." These eye-plates should, he stated, be fitted clear of the upper works, so that no difficulty would confront the divers in reaching them or in shackling the chains. The eye-plates should be grouped in pairs, each pair of plates being the same distance apart as the hawse pipes of the pontoons, and the different pairs spaced so that the pontoons cleared each other when in position. Each eye-plate was to be well secured to the hull structure, and tested to the breaking strength of the chain to be attached to it. Ellsburg proposed to arrange for twenty eye-plates in submarines of the "S" class, which with pontoons of the same net lift as used for "S 51's" salvage would permit of the full lift of 800 tons being applied by pontoons alone. He considered that with these fitted and the pontoons available, the time required for salvage should not exceed two days, and the saving of life from a sunken submarine would therefore be practicable. He also suggested independent external air connections to each compartment in place of an external pipe with branches to the different compartments, such as was fitted in "S 51," but was broken in the collision and remained useless for the salvage operations. Another suggestion was the enlargement of all access hatches in the submarine to allow divers to enter the vessel without difficulty. This report was dated October 2nd, 1926, but as the proposals had not been adopted, the salvage operations of "S 4" followed the same lines as those of "S 51." The opinions of the heads of the Navy Department on Ellsburg's suggestions were elicited by the Navy Committee of Congress in the spring of this year, and published in their entirety. They agreed with him that pontoons were preferable to surface vessels for submarine salvage, and stated that although Germany had built two special craft for this purpose, and France, Italy, Holland, Spain, and Brazil one each, the only recorded instance of the successful use of such a vessel was in the salvage of "U 3," which sank in 45ft. of water in Kiel Harbour in January, 1911. To this solitary example must now be added the Italian submarine "F 14," raised from a depth of 100ft. in thirty-four hours after sinking, but unfortunately too late to save the lives of any of her crew, who were asphyxiated by chlorine gas from the batteries not long before their vessel was brought to the surface.

According to the information given to the U.S. Navy Committee, the design and construction of a special submarine salvage vessel had been considered by the Navy Department, but it was the opinion of all experienced officers that it could only be of use in the calmest water, and that in a seaway the lifting chains would fracture in succession. As a result of accidents to European submarines, lifting eyes had been first fitted in U.S. submarines in 1905, but the increasing displacement of later types had rendered the eyes of very doubtful value, and their fitting had been discontinued in 1913. It had been estimated that for an "S" class submarine, the weight of the twenty eye-plates recommended by Ellsburg, and the strengthening of the hull structure in their vicinity, would amount to 9 tons, an additional weight which would reduce the stability to such a dangerous extent that it was inacceptable. For the largest submarines, "V 4" to "V 6," of 2890 tons, eighteen pontoons, each with 130 tons net lift and thirty-six eye-plates, and in "V 1" to "V 3" of 2200 tons, fourteen pontoons of the same lift, and twenty-eight eye-plates would be necessary. It was agreed that they would facilitate salvage, and that there was a possibility of saving life, but the probability was very small. Ellsburg's statement that with eye-plates fitted on the submarine, a pair of pontoons could be connected in two hours, was considered far too optimistic, the records of "S 51's" salvage showing that the shortest time in which two pontoons had been placed in position and the chains secured was twelve hours. This time allowed for no preliminary preparations. Although for stability reasons the addition of the large number of eye-plates proposed by Captain Ellsburg was impossible, the fitting of one or two towards the ends of the vessels was still being investigated, as it appeared possible these might prove useful in certain eventualities. It was stated that it had been decided to fit an independent external air connection to each main compartment of all submarines, to facilitate the work of the divers in coupling the hoses bringing compressed air, in the event of salvage becoming necessary. To diminish the chance of collision between surface vessels and a submarine coming to the surface after a submerged run, it was proposed to provide smoke or flame signals, which would be discharged from the submarine at short intervals, thus indicating the presence and the course of the submerged vessel. The design of a helmet for use by the crews of submarines in case of accident was being proceeded with, and the construction of a number of pontoons to be stationed at submarine bases for salvage work was also contemplated.

Submarine officers who were present at the meetings

of the Committee, and who were called upon to give their views, expressed their general agreement with the evidence given by the departmental heads, and stated that they preferred that all safety arrangements should be of a character such that they could be operated and controlled by the officers and crews of the submarines.

The witnesses were also questioned by the Committee on the merits of the various suggestions for saving life which inevitably appear in the public Press on the occasion of every submarine accident, the sinking of "S 4" being no exception. This matter had been previously reviewed in a paper presented in February last to the Académie des Sciences by the veteran naval architect, Monsieur Max Laubeuf, whose knowledge and experience of submarines are probably unrivalled. The most common of these suggestions is the detachable buoy, which has taken several forms, the earliest being an ordinary wooden mark buoy stowed in the upper works of the submarine, attached to it by a light steel wire rope, the buoy being released by a simple mechanism operated from the interior of the vessel. In a later form the buoy is constructed of a spherical shape of light steel plating, sufficiently thick to withstand the water pressure, and contains a telephone accessible through a water-tight cover at the top by which communication between surface vessels and the submarine's crew is established. Still later the steel wire buoy rope was replaced by a wire wound hose about 2in. diameter, through which compressed air or liquid food could be supplied to the submarine. Monsieur Laubeuf states that this form—the telephone-air-tube buoy—has been fitted in the majority of modern submarines. According to the United States evidence, the buoys in all American submarines were removed when the United States entered the world war, it having been reported that a buoy had been released from a German submarine by the explosion of a depth charge, and revealed her position to the Allied ships searching for her. It was also stated that an American submarine undergoing a depth test had released a telephone buoy for the purpose of communicating the progress of the test to the attendant surface vessel, but the buoy failed to reach the surface, and had been lost. Although the buoys removed in 1917 were still available, no suggestion for their replacement had been received from the submarine flotillas. In the accidents to "S 51" and "S 4" there had been no difficulty in finding their positions, the escape of oil and air serving the purpose, and in "S 4" the survivors had been communicated with. Monsieur Laubeuf remarks that these buoys are not strictly life-saving appliances. Although if released they give the position of the vessel and afford a means of communication with the survivors, there still remains the difficult problem of rescue or salvage. In the published accounts of the accident to the Italian "F 14" there is no mention of telephone buoys being used, the position of the vessel and the number and condition of the survivors being obtained by submarine signalling apparatus. In a very recent patent the air hose of the telephone buoy is increased to a diameter sufficient to allow a man to pass through.

According to Monsieur Laubeuf, all methods of saving life from sunken submarines which have been suggested fall into three categories. The first is represented by the open-ended steel tube about 70 cm. diameter and of sufficient length to reach from the submarine to the surface, the lower extremity being enlarged to enclose an access hatch of the submarine and to allow the hatch cover to be opened into it. A water-tight joint between the hull of the submarine and the lower end of the tube having been made by divers, the water in the tube is then pumped out, the hatch cover opened and the survivors ascend the tube. Variations of this proposal have been the subject of many patents, but there is no record of its use. Monsieur Laubeuf considers it might be effective in a depth of water not greater than 20 m., if the position of the submarine is free from strong tides and heavy seas. The difficulty of securing and maintaining the water-tight connection between tube and submarine is referred to, and also the danger to the survivors, if, in a compartment open to the sea, the opening of the hatch released the air compressed in the upper portion of the space and permitted the complete flooding of the compartment and the tube. In his account of "K 13's" accident Professor Hillhouse states that a tube of this sort was constructed by the Fairfield Shipbuilding Company in one night and sent down to the Gareloch. The successful efforts of the survivors in floating the forward end of the vessel made the employment of the tube unnecessary.

In his second category Monsieur Laubeuf includes the various types of releasable buoys, and refers to four. The first is the telephone buoy, which has already been mentioned. In the second, the buoy rope is attached to a heavier steel wire rope, which is used to bring to the surface a strong chain secured to the hull and intended for use as a lifting chain by the salvage vessels. This, he states, has the advantage that divers are not required, and for depths over 50 m. —the limit to which divers can work—might prove useful. He does not mention the addition in the upper works of the submarine of the weight of the steel wire ropes and chains, an increase which must necessitate a larger submarine and difficult questions of stability.

This objection does not apply to the third type of buoy, in which the buoy rope is intended to be used as a guide for lowering a coupling fitted at the end of a lifting chain, and which, on reaching the submarine, automatically engages with a suitably shaped forging strongly attached to the hull of the submarine. This form, he states, has been the subject of several patents, but its use has been completely abandoned. The weight of the modern submarine—400 to 1000 tons—would necessitate several of these buoys and lifting chains, and the difficulty of obtaining equal strains on the several chains when attempting to lift in a seaway, and the consequent fracture of chains or securities on the hull, making it impracticable. The same objection might also be urged against the second description of buoy.

The fourth and last type of buoy mentioned by Monsieur Laubeuf is of greater size than the others, being of sufficient capacity and buoyancy to contain the crew and rise with them to the surface. This buoy, or lifeboat, has a machined ring on its underside which rests upon a seating on the submarine's hull, a water-tight joint being obtained by the securing bolts, which can be released from the interior of the buoy. Within this ring is a manhole in the bottom of the buoy, and opposite it another in the submarine. In case of accident the survivors pass through these manholes from the submarine to the buoy, the manhole in the latter being closed when all have entered. The buoy is then released by those inside it and rises to the surface, a manhole in the top, opened from inside, allowing the survivors to escape. A buoy of this description was fitted in the "Plongeur," built in France in 1865, the crew numbering five or six, but was never used. Monsieur Laubeuf states that this fitting is too heavy and cumbrous for small submarines, whilst for modern types with crews numbering from forty to eighty it is impracticable, the size of a single buoy being too great, and space and weight being unavailable for several of the same total capacity. There is also the risk that in a collision, the cause of the majority of accidents, the buoy may be damaged and become useless for its intended purpose.

In his third category, Monsieur Laubeuf places the air lock, a small water-tight compartment fitted with doors at bottom and top, which are opened in turn, whilst a survivor enters the lock from the submarine or emerges from the top into the sea, both doors being closed whilst the water in the lock is pumped out previous to the entry of another survivor. He states that all submarines have at least one such air lock, and presumably refers to the conning tower. He is doubtful if it would be of use in an emergency, the sinking of the vessel being too rapid, and the compartment from which access is obtained to the air lock being perhaps flooded. If the air lock is accessible and the depth of water is greater than 20 m., there is a danger to the lives of those who escape by the air lock, in passing too rapidly from the pressure due to the depth to the atmospheric pressure at the sea surface. To decrease this danger diver's helmets should be worn, and these, the writer states, are carried by British and American submarines. Recent newspaper reports indicate that the U.S. Naval Authorities have perfected a device for this purpose. It consists of a rubber container filled with oxygen, from which two tubes lead to a fitting placed over the mouth. The exhaled air is purified by passing through caustic soda, is enriched by the oxygen, and again inhaled, the nose being closed by a clip. An officer descended in a tank to a depth of 155ft., and wearing the device rose to the surface in 505 seconds, purposely checking the speed of ascent by grasping a rope attached to the tank. He was then placed in a chamber, the pressure of air in it being 45 lb. per square inch, gradually reduced to atmospheric pressure. He suffered no ill effects from the experiment. Two naval divers with similar devices reached the surface in 335 and 251 seconds respectively.

Monseur Laubeuf states that the devices to which he refers in his paper are to the best of his knowledge quite inefficacious for the purpose of saving life, the rapid sinking of the submarine in case of accident preventing the crew from using them. The damaged vessel generally sinks bow or stern first, and only a few of the crew get the opportunity of taking refuge, usually in an end compartment. He proposes, therefore, that the two extreme spaces should be constructed as refuge compartments, and fitted with external connections to which divers can fix hoses for the supply of air and liquid food to the survivors whilst salvage operations proceed. He is very doubtful, however, of their eventual rescue, if they have to depend upon outside help alone, quoting the times required for the salvage of sunken submarines of several navies. Unless the conditions are very favourable, *i.e.*, depth of water not more than 20 m., position free from tides and seas, and the survivors able to assist, Monsieur Laubeuf is of the opinion that the saving of life is improbable.

In concluding his review, Monsieur Laubeuf suggests that to reduce the loss of life in submarine accidents, every effort should be directed to the provision or improvement of those features which may delay the sinking of the vessel, and thus gain time for the crew to escape. He states that a safety weight in the keel at the middle of length, and instantaneously released by the turning of a lever, has proved useful on several occasions when the leakage of water into the submarine was small. He also alludes to the system by which the store of compressed air in the submarine is distributed and operated, and which should be so designed, that the whole of the air can be brought quickly and easily into use for the expulsion of water from all tanks, thus gaining buoyancy.

The impression left after a study of the evidence given to the U.S. Navy Committee, and also of Monsieur Laubeuf's paper is the melancholy one that in the majority of submarine accidents the saving of life is very improbable. The meetings of the Committee to which reference has been made are, we believe, the first occasion on which the difficult problems of saving life from and the salvage of sunken submarine have been publicly discussed, and at which the opinions of the heads of the responsible Government Department have been so freely and fully expressed. For that reason alone the evidence is of more than ordinary interest.

Light-Controlled Electrical Circuits.

It has long been known that the effect of light on a selenium cell or bridge is to lower its electrical resistance, and coversely when the light is cut off the resistance is raised. The possibility of controlling electrical circuits by means of light would, therefore, appear to be a fairly simple matter, but until recently the scheme has not been put to much practical use. By means of a new and patented selenium bridge, however, the Radiovisor Parent Company, Ltd., of 26, Coventry-street, has succeeded in controlling electrical circuits in a very efficient manner, and the company has applied the scheme to the operation of burglar alarms, the lighting of electric street lamps, and to automatic railway control, &c.

One of the difficulties in the past seems to have been that of producing reliable selenium cells, but the new cell or bridge, used by the Radiovisor Company is claimed to be

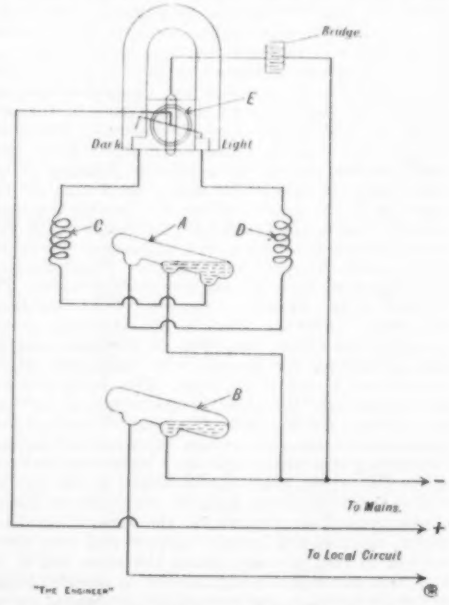


FIG. 1—CONNECTIONS OF LIGHT-CONTROLLED CIRCUIT

a marked improvement on all others that have been produced. In the manufacture of this new bridge a plate of transparent material such as acid glass, has a number of lines formed with a solution, commercially known as silver G, and containing gold or platinum impressed upon it. The lines form two combs arranged like the plates of a condenser and are completely separated from one another. After the lines have been made on the plate by means of a stencil or other suitable device, the glass plate is fired at a temperature in the neighbourhood of 325 deg. Cent. so as to make the line electrodes adhere to and become incorporated with it. After cooling has taken place, the lines which form the electrodes are given another coating of the metallic solution, and the glass is again fired. The processes mentioned are, in fact, repeated until the metallic lines have a conductance suitable for the conditions under which the bridge is to be used. The glass plate is then heated to a temperature in the neighbourhood of 200 deg. Cent. and the metallic lines and spaces between them are thinly coated with selenium, which is afterwards annealed, and the bridge is seasoned in the usual manner. The bridge is mounted in a glass envelope, similar to that belonging to a thermionic valve, but the elements are not, we understand, under vacuum. A selenium bridge made in this way may be used on circuits working at ordinary supply voltages, and, in fact, very much higher voltages. The bridge is also said to be extremely reliable in operation.

One of the uses to which this new bridge has been put is, as we have said, that of operating a burglar alarm. The bridge is connected to a sensitive relay which controls the circuit of an electric bell that is set into operation when a burglar passes between a ray of light and the bridge hidden from view. In order that the burglar may not see the light only the infra-red rays are used. On entering a room equipped with the apparatus, nothing whatever is to be seen, but it is quite impossible for anyone to pass through the invisible rays without causing the apparatus to ring the bell, which, of course, can be placed in another part of the building or, if necessary, at a distant point.

Another interesting application of the scheme is that of lighting and switching off electric street lamps, a scheme which, we understand, has proved very successful at Barnes. As shown in the diagram Fig. 1, a selenium bridge is con-

nected in series with a relay across the supply mains, and owing to the action of natural light or darkness on the bridge the relay is made to light the street lamps or switch them off automatically. There are two mercury switches A and B, which are mechanically connected. The function of the switch A is to energise one or the other of the actuating coils C and D, whilst the switch B controls the local circuit to which the street lamps are connected. The armature of the relay E is shown in the position it takes up before darkness, but when darkness sets in and the resistance of the bridge increases it moves in the counter clockwise direction under the action of its spring. The coil C is then energised and the switches A and B are tilted downwards at the left-hand end, so that the switch B completes the local circuit and switches on the lamps. It can easily be seen that when daylight arrives and the resistance of the bridge diminishes the lamps are automatically switched off, for the two mercury switches are

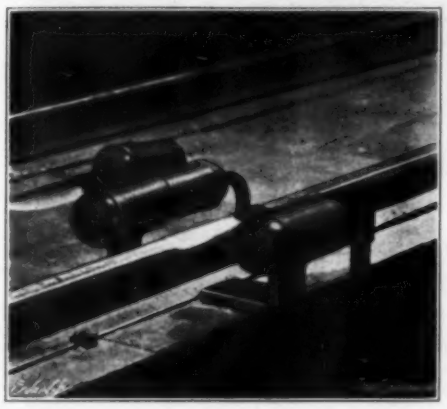


FIG. 2—TRACK EQUIPMENT FOR SIGNAL CONTROL

then tilted in the opposite direction. The current controlled by the switch A is only a few micro-ampères, but that which passes through the switch B is, of course, that consumed by the lamps.

In applying the selenium bridge to automatic train control, the track or permanent way may be regarded as being divided up into a number of sections, the requirements for efficient control being that it shall be impossible for more than one train to run on the same section of track. If, at the commencement of each track section, a bridge and lamp be placed in such a way—see Fig. 2—that the passage of a train cuts off the beam of light from the bridge, the bridge may be caused, through a relay, to operate a signal situated at the commencement of the previous section, thus indicating to any following train that the section ahead of it is blocked. Considering the matter of automatic train stopping, a lamp or series of

FIG. 3—DEMONSTRATION RAILWAY

lamps are arranged on the permanent way in the neighbourhood of the signal in such a manner that on the signal being put to danger these lamps automatically light up and cause a beam or beams of light to be projected along the track in the direction of an oncoming train—see Fig. 3—so that in the event of this second train overrunning its danger signal it will come into range of the train-stop light. If on the locomotive or foremost part of the train there is a light-sensitive bridge connected through a relay and trip mechanism in such a way that when the train comes into range of the train stop it will immediately trip the air braking mechanism, the train can be brought to a standstill. The relays for each section of track are interconnected by a single trip wire in such a manner that on the first train proceeding on to the section ahead it will automatically release the first relay, signal and stop lamp, thus releasing the air brakes and allowing the following train to proceed. It will be understood that the train stop should only cause the brakes of a following train to be applied in the event of the driver overrunning his signals. If it is desired to cause a section of track behind any train to become dead in the case of electric traction, the result can be secured by the bridge and relay in a similar way or in conjunction with the train stop lamp by means of suitable circuit breakers.

The advantages claimed for the system over existing systems and the features, coinciding with the published requirements of the Committee set up to inquire into train control, may be set forth as follows:—(1) Total elimination of the human element: (2) great simplicity of equipment required; (3) low maintenance costs owing to the fact that no moving mechanical parts, such as train stop arms, &c., are employed; (4) low initial cost of installation; (5) the system may be operated throughout from any existing electric supply systems; the current consumption being very low, the section equipment may be fed from lines carried on existing telegraph poles; (6) no mechanical or electrical contact between track and train, the whole system depending on the cutting off or application of a beam of light; (7) owing to the sensitivity of the "Radiovisor" bridge to the infra-red or fog-penetrating rays, the system will work under all weather conditions and will be of value in train control during fog, as the train may be caused to operate an audible as well as a visible signal; (8) the system is positive in its action, any fault occurring instantly putting the signal to danger and at the same time providing an indication in the control cabin by means of an indicator and alarm; (9) the system provides complete indication to the traffic superintendent as to the movements of trains on any part of the system by means of a train diagram.

A further application of the "Radiovisor" light-sensitive bridge is the automatic lighting of trains, of signals and stations. By means of this system the lights are automatically switched on at the approach of darkness, and of fog and switched off when light becomes normal. In the Radiovisor demonstration rooms at 26, Coventry-street, W. 1, are working models of a ¼in. scale steam track and a complete six-section electric track.

The Painting of Steel Chimneys.

By A. H. D. MARKWICK, B.Sc.

ONE of the disadvantages of steel chimneys is that they require to be painted periodically. The work differs from ordinary routine painting in that if the chimneys are of any great height, steeplejacks have to be employed, and that in general special paints are required.

For smaller chimneys, the works maintenance gang may be able to tackle the work. Where this is not done, a common practice is to invite quotations from steeplejacks in the district, who visit the site and submit a lump sum price covering labour and material. For larger contracts it is worth while to go into the matter in greater detail. The contract for the labour is often placed separately, and the paint ordered direct from the manufacturers. In this way the engineer is able to control directly the quality of the materials used.

Although contractors may be asked to submit a lump sum price after visiting the site, it is an advantage to attach to the inquiry a schedule giving the approximate areas to be covered and giving the sizes of the stacks. The contractor should be able to give a price from these data alone, but it is of course desirable that he should also see the work which he is asked to do before submitting his tender.

Where the importance of the work may warrant the preparation of a specification, it may be advisable, in addition to providing that the risk of accident is to be borne by the contractor, to insist that he should also insure against accident risks. Doubtless, because premiums asked are high, many of the smaller steeplejack firms do not insure. In the event of an accident, should the contractor be unable to pay compensation, it is possible for the injured party to enforce a claim against the firm or corporation employing the contractor. A clause in the specification should also provide that no work should be undertaken on the chimney whilst it is being used. With a brick chimney it is not uncommon to undertake work on it whilst the chimney is in commission, but the risks are greater with a steel chimney for several reasons. The cope ring at the top is usually fairly narrow, and there is a danger of being overcome by the fumes whilst working at that level. There is also the danger of the charring of the ropes. In case a chimney requires to be put on load unexpectedly, the engineer should have power to compel the contractor to cease work for good and sufficient reason, and to prevent the possibility of unreasonable claims it may also be provided that the contractor should in this case have no claim upon the engineer, although the engineer is morally bound to allow reasonable claims on this account.

No painting should be allowed in rainy weather, as the paint is liable to blister when painted over a moist surface.

With regard to the work specified to be done, it will usually be sufficient for the contractor thoroughly to wirebrush, remove all loose rust and paint, and apply the specified number of coats. It is advisable to state that the paint should be applied with a short brush. Some contractors, if allowed to do so by the engineer, will apply the paint by means of a long brush at the end of a long handle. Where the paint is very fluid this may be allowed, but usually the consistency of the paint is such that it requires to be thoroughly worked in with the brush. The difficulties of working from a suspended "bosun's chair" must be borne in mind in this connection, and it is not reasonable to expect quite the same standard of work as if the painting were done from a solid scaffolding. Where there are numerous chimneys to be painted, it may be worth while to provide a permanent and more substantial cradle in place of the "bosun's chair," although steeplejacks themselves will probably prefer the latter.

Paints.—The temperature of the flue gases in the chimney in a modern plant should not exceed 450 deg. Fah. and the temperature of the chinney surface will probably not exceed from 350 deg. Fah. to 450 deg. Fah. There is a large number of paints on the market which are designed to meet these conditions. They may be considered as belonging to three main groups, viz., graphite—boiled oil paints, bituminous paints, and paints using special heat-resisting oils.

Graphite paints adhere well to the steel on account of the inherent greasiness of the graphite particles. The more expensive brands of graphite paint are composed of flake graphite, the advantage of which is that the particles leaf together by themselves so that after the oil has perished, the paint film will remain intact. It is also possible to make graphite paints with special heat-resisting oils. Paints of this type are very satisfactory as heat-resisting paints, particularly on boiler casings where temperatures are exceptionally high.

Numerous bituminous coatings are also in use, many of which are sold under trade names. Very little information is available regarding their composition and prices vary from about 1s. per gallon for prepared tar to about 6s. per gallon for paints sold under proprietary names. It is probable that most of them are derived from coal tar by distilling off the more volatile constituents and adding oils. In the case of the enamels, resins are also added. A good deal of experience is required in the manufacture of bituminous paints, and it is natural that the manufacturers should not be keen to disclose the actual process of manufacture. In addition to the bituminous binding material, some smoke stack paints would appear to contain a pigment consisting of carbon black.

As the cost of the paint forms only a small proportion of the total cost of painting, it is not wise to attempt to save money on the cost of the paint at the expense of its quality. Particularly in the case of bituminous paints it is wise to buy from manufacturers who have an established reputation for paints of this class. Inferior qualities of bituminous paint harden and scale off in time, and this adds greatly to the labour cost when repainting is necessary.

A portion of the chimney is frequently protected from the weather, as it is inside the boiler-house. For painting this a black japan varnish has recently been suggested, the heat of the chimney baking on the coating. Provided the latter is sufficiently elastic to withstand the extremes of temperature, the plan would seem to be a good one.

On the funnels of steamships it is usual to use coloured paints, but they do not appear to be generally suited to the painting of industrial chimneys. Even if a black band of considerable depth is allowed around the top of the chimney, it is found that the smoke discolours the paint below this and gives an extremely ugly appearance. In addition, coloured paints do not possess the heat-resisting properties of the black paints, and this applies in particular to the bituminous paints. It should be borne in mind that the funnels of a steamship are usually composed of an inner and an outer casing, and that in general the temperature of the latter is considerably below that of the portion in contact with the chimney gases.

The portion of the chimney which suffers most from corrosion is undoubtedly the interior. To find a protective coating which will stand up to both heat and fumes present great difficulty, and on many chimneys no painting at all is done to the interior, the theory being that the cost of this work is entirely wasted. There is no doubt that by annually cleaning off the rust and scale and painting, the rate of corrosion can be greatly diminished. If the allowance for corrosion made in the design of the chimney has not been very great this treatment may become essential.

Corrosion would appear to take place chiefly when the boiler is being taken off load. The outer shell of the chimney becomes cold whilst the hot gases continue to rise from the boiler as the furnace brickwork cools more slowly. Moisture will condense on the steel from the warm air, and this, acting with the sulphurous deposit inside the chimney, would appear to be responsible for the damage. The treatment suggested for the side of chimneys is a coat of red lead followed by a coat of graphite paint. As is well known, red lead paint is especially effective for inhibiting corrosion when used as a priming paint.

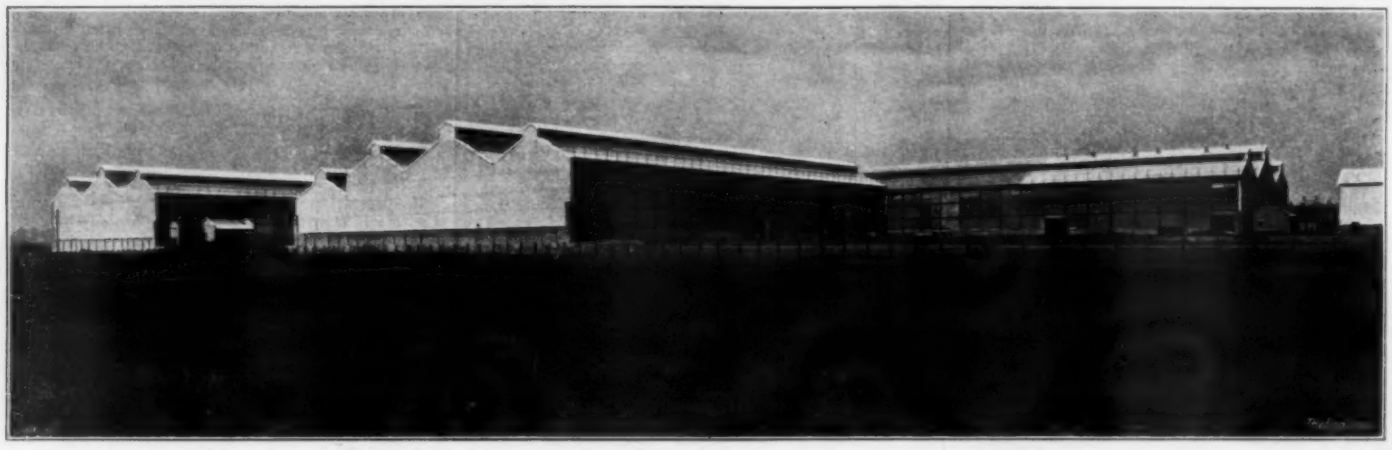
The usual method of constructing steel chimneys would appear to call for criticism. The plates are overlapped so that no ledges are formed on the outside on which water can collect. Moisture, however, may collect on the ledges inside the chimney, and when old chimneys have been dismantled it is found that corrosion is especially severe at this point. If the ledges were put outside it would be possible to protect them against corrosion by painting, or by forming a chamfer on the ledge of the plate so that moisture would not collect, whereas it is not possible to protect the inside of the chimney adequately.

The alternative to an unlined chimney, such as have been referred to here, is to line the chimney throughout with firebrick. This is the best way of preventing corrosion, but is expensive and with a high chimney appears to be liable to cause greatly increased stresses when the chimney sways in the wind.

With regard to the cost of painting, a figure from 8d. to 1s. per square yard per coat is not uncommon, and is a useful basis for estimating. The cost of the labour as a percentage of this varies from 75 per cent. to 90 per cent., according to the quality of the paint used. For a paint of good quality a typical figure is 80 per cent. These figures emphasise the importance of obtaining a good and suitable paint.

THE INSTITUTION OF PRODUCTION ENGINEERS.—The fifth annual dinner of the Institution of Production Engineers was held at the Holborn Restaurant on Saturday evening, November 10th, with Sir Alfred Herbert, the President, in the chair. There was a fair attendance of members and guests, and had the date not been the eve of the Armistice celebrations it is probable there would have been more present. After the toast of "The King" had been proposed by the President, Mr. L. H. Hounsfield proposed "The Institution," the aim of which, he said, was to increase the saleable production per man employed. He suggested that machine tool makers should concentrate on the construction of special machines, rather than that they should attempt to manufacture a wide variety. He also advocated the same broad principle in the constitution of engineering institutions. In responding, Mr. A. J. Hancock pointed out that it was not only necessary to reduce the cost of production to meet foreign competition, but it was also necessary to maintain our national characteristic for excellence of quality. "Our Distinguished Guests" was proposed by Mr. L. H. Pomeroy and was responded to by Mr. J. B. Hobbyn. The toast of "The President" was proposed by Mr. R. H. Hutchinson. A pleasant programme of entertainment was provided.

THE DERBY WORKS OF INTERNATIONAL COMBUSTION, LTD.



GENERAL VIEW OF THE WORKS FROM THE SOUTH EAST

The Derby Works of International Combustion, Ltd.

LATELY we had an opportunity of re-exploring the works in Sinfin-lane, Derby, of International Combustion, Ltd. We say re-exploring, as just five years ago we visited the then comparatively new works, and gave a description of them in our issue of June 22nd, 1923. Since then, however, the activities of the company have been greatly extended along the original direction, and by the addition of the Lopulco business which was formerly carried on at Barrow-in-Furness. The result is that the original shops have had to be extended very considerably, while a large new shop has had to be put up to accommodate the structural steel work associated with the Lopulco powdered fuel burning plant. The magnitude of these extensions may be gauged by a comparison of the plan which we reproduce in Fig. 1 and that published in our previous article, while the engravings on page 548 and herewith give an impression of the present extent of the works. At the time of our first visit, the whole of the buildings occupied only a narrow strip along the north side of the company's land, which latter measures nearly a quarter of a mile square. Now, the occupied area, which is fenced off from the remaining meadow land with old torpedo nets, represents over one-third of the total of 20 acres which were reserved, in the first instance, for works development. The meadow land referred to above, owned by the company, totals about 35 acres.

Taking first the offices, the building has been extended longitudinally to nearly double its original length, so as to give more accommodation for the clerical staff, and to provide room in the drawing-office for sixty draughtsmen and tracers. It should be pointed out, however, that that is not the full extent of the designing staff, for which the shops have to produce results, as some of the draughting work is done in the London office; in fact, the whole of the proposal drawings for schemes submitted to possible clients are done there. The detail and working drawings, generally, are dealt with at the Derby works. The company employs from eighty to one hundred people in the drawing-office in London. The extensions have also enabled the provision of a commodious office for Mr. R. Greenwood, the general manager and resident director, with windows overlooking a large part of the works. A garage with room for three cars has been built facing the offices, and there is now a canteen capable of seating about 700 workpeople, with separate rooms for the staff. The kitchen is exceptionally airy, and employs gas for heating and cooking. It is the rule of the works that the men should leave any food which they may bring with them in the morning in the canteen dining-room at their habitual seats. The room is then locked up until the meal time. The food is, consequently, kept out of the shops, to the benefit of both the food itself and the orderliness of the shops. Finally, a workmen's club hut has been put up in a separate enclosure, with an opening on the main road. This club has a billiard table and a licence. Furthermore, the hut is the headquarters of the works sports organisation, which runs football teams, cricket elevens, fishing clubs, &c., and holds dances, whist drives, social evenings, lectures, &c., in the winter in the canteen, which is lent free for the purpose by the company.

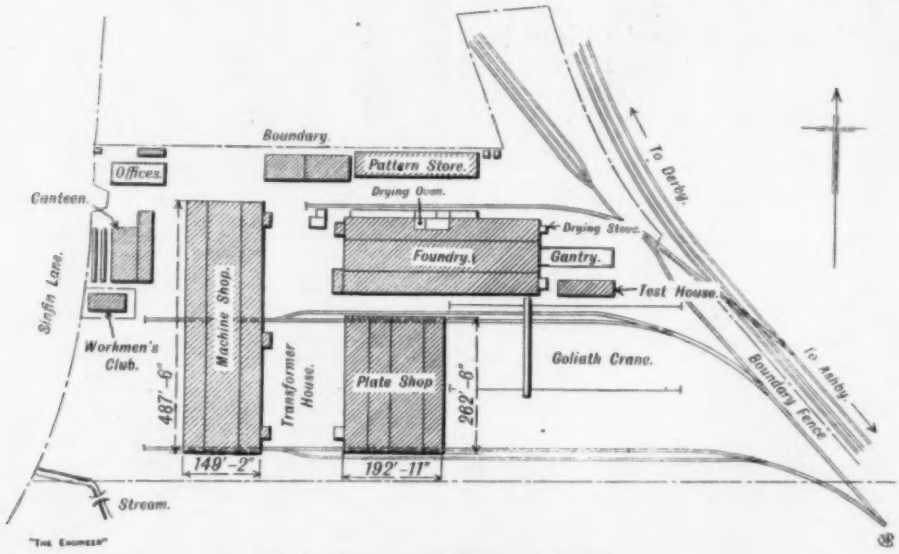


FIG. 1—PLAN OF WORKS AND SIDINGS

The machine shop—see page 548—it will be remembered, was originally 150ft. wide by 226ft. long. It is now 496ft. long. This extension has been effected by the addition of seven more lengths, or bays, similar to those of the original building, with the exception that the opening fan lights in the roof lantern have been replaced by louvres. The original structural arrangement has been retained, with the main colums spaced at 37ft. 6in. centres, with intermediate stanchions at 12ft. 6in. centres in the machine shop only, for the purpose of carrying various countershafts and in some cases short lengths of line shaft. The middle span is of 60ft., and the two outside ones 45ft. The centre bay is served by a 15-ton and two 5-ton travelling cranes, and the outside bays each have a 2-ton and a 5-ton crane. There are also a dozen 1-ton electric jib cranes on the columns of the new extension, as this part of the shop has been set aside for erecting work—see page 548—and it is naturally not good practice to keep a travelling crane at one place holding a piece of machinery while it is being fitted in place. The motors of the jib cranes are operated by ropes from the floor, while the travelling cranes have overhead cabs for the drivers.

As a consequence of the extension, it has been possible to rearrange the machine shop proper, and now all the heavy machines are grouped in the centre bay, with the lighter ones on either side. The larger machines have individual drives, while the automatics and so forth are driven off short lines of shafting attached to the columns near the floor level, driving up to countershafts about 14ft. from floor level. These line shafts are driven by 40 H.P. motors. There are also two lengths of overhead shafting in the west bay, each driven by a 20 H.P. motor. The equipment includes four Hilo planing machines and another planer, also by Stirk, which prove very useful, as many of the stoker castings have several facings some distance apart which need planing, and the Hilo arrangement minimises the time spent while the tool is not cutting. There is also a big centre lathe which is used for turning up the tumbler shafts for chain grate stokers, that may be as long as 26ft. by 10in. in diameter. It is noteworthy, however, that with the exception of small parts, such as may be produced on automatic machines, there is little turning work in the construction of these stokers. On the other hand, a great number of accurately formed castings is required, so that the foundry is of paramount importance.

FIG. 2—EAST END OF FOUNDRY

The foundry, two views of which are given in Figs. 2

and 3, has been extended by approximately three-sevenths in area. The cupolas are installed in the north bay, with the spouts running into the centre bay, and whereas, originally, they were towards one end of the building, they are now in the centre of its length, so that the most distant flasks are still served with equally hot metal. The building has the same arrangement of bays as the machine shop—that is to say, a 60ft. centre span and two side spans of 45ft., the main stanchions being at 37ft. 6in. centres. The total length of the building is 375ft., and as it runs east and west, the roof is glazed only on the north. Both vertical sides are, however, fully glazed. The result

FIG. 3—WEST END OF FOUNDRY

is that it is one of the best-lit foundries we have ever visited. In this connection, it may be remembered that in our previous description of these works we commented on the remarkable evenness of temperature maintained in these great glass buildings, and we can now endorse those remarks, as our new visit was made during a spell of really hot weather. Even with the sun blazing on the roof, and the day's cast being poured, it was more comfortable to be in the foundry than walking up the lane outside.

There are two 7ft. cupolas, with a capacity of 12 tons per hour, and a 4ft. 6in. cupola for melting special mixtures of iron. These cupolas are blown by two high-speed electrically-driven fans in a lock-up building, which also serves to accommodate two electrically-driven air compressors for working the moulding machines. The materials for charging the cupolas are raised to the charging floor by an electric lift. Near the entrance to the foundry there is a sand-preparing plant which comprises two Simpson 6ft. diameter sand mills fitted with August's aerators and elevating plant for charging the mills; two Hum-mer screens, which are made and supplied by International Combustion, Ltd., and several other types of electric riddles, and mills for dealing with oil sand, core mixes, &c. Right across the shop, towards the east end, there is a row of pneumatically-operated moulding machines for producing a range of castings from ½ lb. up to 3 cwt. The south bay is used almost exclusively for plate and machine moulding and various types of hand and air-operated machines are installed. A very big proportion of the centre bay of the foundry is used for jobbing moulding in green sand, dry sand and loam, in weights varying from a few pounds up to 14 tons. This foundry deals with a very variable p oduct, as the company's manufactures change to such an extent on account of varying conditions of different installations that it is impossible to produce a'l the castings by machine moulding or plate moulding methods. We noticed also that a considerable quantity of material was made by an improved method of snap flask moulding, of which we understand Mr. Greenwood is the patentee. The product from these machines is put down on a special floor for casting. Hot metal is required all over the foundry, and as the cupolas can melt 12 tons an hour, an effective transport system is necessary; and it undoubtedly exists. The normal production of the foundry is about 150 tons per week. Previous to the recent extensions, the normal production was about 100 tons per week.

Although the castings made are almost exclusively in iron, there is a small non-ferrous foundry on the north side of the building for making bushes, &c. The whole of the foundry floor is commanded by six Royce overhead travelling cranes, one of which is of 15 tons capacity, two of 5 tons capacity, and the remainder of 3 tons, together with half a dozen 1-ton electrically-operated jibs attached to the main stanchions in the centre bay to facilitate the rapid coreing of work, of which there is a considerable quantity. There is a gantry extension to the east-end, so that heavy flasks, spiders and so forth may be taken out into the open for storage.

An entirely new department which has been instituted just beyond the foundry is the test-house or demonstration plant. It is equipped with several sets of full-sized typical coal-pulverising machines, which can be used to demonstrate to prospective customers the merits of the several types.

On the occasion of our visit there was also at work an experimental plant with which a new process of grinding coal was being tested, while arrangements were being made for the erection of a dummy furnace, in which full-sized trials of stokers will be carried out.

The new plate shop—see page 548—is perhaps one of the most interesting parts of the works, as such a wide variety of work is carried on there, and although it had only been finished a few weeks before our arrival, it was so full of work, that gangways had ceased to exist, and the whole floor was covered with jobs. In this regard, we would point out that an area of 250ft. by 600ft. at the east side of the plate shop is being excavated and levelled, and on this open space a 6-ton Craven goliath crane is being installed, the rail centres of which will be 160ft., with 30ft. cantilevers overhanging on each end. This machine will travel 500ft. from the plate shop to the east and will effectively cover for transport and storage purposes and also for outside erection an area of 200ft. by 500ft. Mr. Greenwood explained that as soon as this machine is in operation, he will be able to deal more effectively with the congestion in the plate shop.

FIG. 4—STOCK YARD FOR CASTINGS

It is in the plate shop that the structural work in connection with the Lopulco system of powdered fuel burning and the forced draught to mechanical stokers is carried out. The building itself is 190ft. wide by 262ft. 6in. long, and is of the same general design as those already described, except that it is divided up into four bays, three of which are 45ft. wide and one 60ft. The construction, as stated, is generally the same as in the machine shop, except that the west bay in the plate shop is some 8ft. lower than the other three bays. All these bays are served by overhead travelling cranes of 2 to 5 tons capacity.

The nature of the work carried out in this shop does not, naturally, require the great quantity of machine tools to be seen in the engineering shops, but the plate shop is well equipped with the latest types of punching and shearing machinery, including hydraulic plate-stretching machines and two rows of radial drills, &c. It is, by the way, the practice of the company to drill all holes, except in sheets so thin that they can be punched by hand. Sets of sheet and angle bending rolls are arranged in convenient places round about the shop. In the east bay there are two quite special machines built by the company for making the Murray fin tubes used for lining the walls of powdered fuel furnaces. These tubes are, of course, built up of a solid drawn steel tube with two fins welded on opposite sides of their diameter. The tubes are 4in. in diameter by about ¼in. thick, while the fins are 1¾in. by ¼in.

The general scheme of the machine is as follows:—The plain tube is laid out in a long V-shaped trough with a narrow table along either side. The fins are placed on these tables, and then are in the correct position for welding. The tube is clamped down in two or three places by stirrups, and the fins are held by little bell cranks pivoted to the sides of the V block. The bell cranks are worked by pistons in transverse cylinders, which are supplied with compressed air. At each end of the V block there is a vertical pnuematic plunger with a fork at the top, which engages with the overhanging ends of the tube, and can be used to lift it out of the V groove, so that it can be easily turned over to weld the opposite side. The welding is effected by the arc process, with hollow carbons and a wire fed down their centre to supply the welding metal. There are two welding heads, for opposite sides of the tube, mounted on a saddle which is fed along a long bed by a lead screw. The beds, &c., are actually the remains of long lathes. The arcs are projected against the corner between the fin and the tube at an angle of 45 deg., so that a good fillet of metal is built up there. The tube is, of course, connected up on the earthed side to complete the electrical circuit. The speed of travel of the welding head is some 7in. per minute, and the machine requires little attention once it has been started, except for the knocking out of the holding-down stirrups, as the weld progresses. The strength of the weld thus produced may be gauged from the fact that the tube can be most completely deformed by hammering on the fin before the fin will part company from the tube. Some of the tubes have to be bent at the ends to join their headers in the plane of the fins, and in such cases the fins are stopped short of the bends, and the bend is made in an ordinary pipe-bending machine. In cases in which it is expected that the tubes will be exposed to very intense local heating, the fins are cut through with a hack saw to minimise distortion.

In the body of the shop a great variety of plating work such as hoppers, cyclones, fuel pipes, air ducts, and so forth is carried out, and the greater part of it might be described as light work in plate of ¼in. or less. A lot of it is, however, of complicated form, and the plates for such work are all marked out from paper patterns which are developed from the draughtsmen's drawings on a special floor near the centre of the shop. In this connection we noticed that the edges of curved plates met together very neatly, and showed that the men on the floor are experts at their job. Most of the joints are welded, but before they are welded they are tack riveted to keep them in shape. Both acetylene and electric welding are employed, but we were told that the electric system is gradually driving the gas system out of the shop. Electrodes of bare and coated wire

are used with the arc style of welding, according to the work in hand.

There are, every here and there about the shop, groups of iron stools bedded in the floor and connected up with the negative side of a special generating set, so that it is only necessary to place a piece of work which needs welding on the stools to get the earth connection. We noticed some rather quick work being done on one of these sets of stools. Some channels required a large number of studs in their flanges, so instead of welding bosses on to the flanges, drilling and tapping them, bolts were dropped through plain holes and the heads were welded to the flanges. One man, with a bare electrode, could easily weld on two bolts ½in. in diameter in a minute, and the consumption of electricity was at a maximum of 5 kW. There is naturally a considerable amount of plain riveting work done in this shop, and for this purpose portable pneumatic machines are provided.

Between the plate shop and the machine shop there is a wide yard, where large pieces of work can be laid out, and there is an acetylene generator there for supplying any blow-pipes which may be required for welding purposes. The upper end of this yard, between the foundry and the machine shop, is, as is shown in Fig. 4, used as a stock yard for castings, and a large quantity is kept there, so that orders for new or replacement parts can be executed promptly.

We have before explained the transport system of the works, and it needs little further description, as the original arrangement proved very convenient for the extensions. For railway traffic there is a turnout from the Derby–Ashby line of the L.M.S. Railway, with a switchback arrangement to get a convenient curve into the works. Near the eastern boundary there is a siding nearly a quarter of a mile long, which can be used for storing trucks, and from it there branch several lines into the shops. The only line which has been materially altered is that which originally ran through the north end of the machine shop. This line now stops short of the shop, so as to leave the end of the building free for the accommodation of heavy machine tools. The machine shop is, however, now served by two other lines, further down its length, which also pass through the two ends of the plate shop. By these means work which requires attention in both the shops can be readily moved from one to the other, while loop lines give a direct route for work that need only go to one of the shops. Trucks are handled about the sidings by a 5-ton locomotive crane. For road transport there is a system of ash roadways, while petrol trollies are used for handling work about the shops.

At the present time there are about 1000 hands employed in the works. The hours in the shops are 7.55 a.m. to 5.30 p.m. for 5½ days, but in the foundry the hours are 7.30 a.m. to 6 p.m. for five days.

Aero Engine Problems in Flight.

A LECTURE which was given by Mr. R. J. Penn before the meeting of the Royal Aeronautical Society on Thursday evening, November 15th, entitled "Aero-engine Problems in Flight, with particular reference to Carburation," was an interesting contribution towards the solution of the many problems which may arise between the completion of the acceptance tests of an aeroplane engine, and its final approval in flight tests. After pointing out the essential differences between the motor car engine and the aero-engine in these respects, Mr. Penn proceeded to analyse the conditions imposed by various oil and water systems and petrol and ignition systems, and, finally, dealt at some length with the question of carburetters and carburation under actual flying conditions. The necessity for efficient cooling of lubricating oil was emphasised, and test figures were given showing the reduction of the oil temperature at various flying altitudes by the employment of a suitably designed cooler. The exposure of the underside of the oil tank to the slip stream and the perforation of the oil tank with air tubes had both been tried with little success, as they produced a drop in temperature of only 2 deg. to 3 deg. Cent. The type of cooler built up of thin elements was much better, and it could be readily increased or reduced to suit actual service conditions. More recently, a new design of turbine centrifugal had been successfully employed, which, it was claimed, not only cleaned and de-aerated the oil, but also cooled it. Such a cooler would seem to have considerable uses in view of the high temperature drop needed when working with superchargers.

In dealing with the various water systems used in aeroplane practice, Mr. Penn outlined the methods employed to test radiators qualitatively, and remarked that quantitative results were not easy to obtain during test flights, owing to the difficulty of devising a small and light flow meter capable of recording flows up to 100 gallons per minute. The vapour separation test was also described, and typical results were given.

Discussing the various petrol systems which are now employed in aircraft work, Mr. Penn said that when looked at from all points of view, he regarded the gravity system as best, for the reason that the head was practically constant, there were fewer fittings, shorter pipes, and therefore greater reliability. It had to be admitted, however, that sufficient head was not always to be obtained from fuselage tanks, and that tanks outside the fuselage were not conducive to clean design.

If the higher duties of the engines were taken into account and the necessity of taking special precautions not to interfere with wireless reception were borne in mind, then the problems of ignition in aero-engines were not essentially different from those of the motor car engine. Drop in air density at high altitudes sometimes caused the safety spark gap in the magnetos to come into operation, and so prevented firing at the sparking plug points. Magneto ignition was to be preferred to coil ignition, as the risk of fire on crashing was appreciably reduced.

The latter half of Mr. Penn's lecture was devoted to the subject of carburetters and carburation. For some years, he said, it was necessary to re-tune engines upon installation in aircraft, owing to altered air conditions. Within the last few years, however, a large amount of development work had been undertaken, and this de-tuning had to a large extent now been eliminated by better balancing of the carburetters and the adoption of a standard intake for each type of engine. The various factors influencing carburation at high altitudes were then discussed, after which the principal types of carburetters now employed in aircraft service were described and illustrated, figures for petrol flow and engine revolutions at various altitudes being given. Finally, Mr. Penn urged that more attention should be given to the important factors of ease of control, flexibility, and rapid acceleration. In the past, power and fuel economy had always been the main considerations, and it was often the case that in present designs of carburetters these two factors were opposed to the three equally important factors referred to above.

A Boiler Breakdown.

IT is, of course, doubtful if a corresponding experience might happen in an engineering establishment; but the following extract from a recent report, issued under the Boiler Explosions Acts, of what may happen if steam generators are not properly attended, is indicative of the conditions under which some such plant is worked, and we republish these remarks with the hope that it may tend towards the better attendance on boilers in general.

"The boiler was used to supply steam to distillers for the distilling of fine liqueurs, and it was the practice to blow a quantity of water out of the boiler twice a week by means of the blow down cock. The blowing down of the boiler was carried out by a stillman named Frederick Brooks. The explosion occurred on a Monday morning, and on the previous Friday afternoon Brooks had carried out the blowing down of the boiler. The blow down cock, which was an ordinary gland cock, had an open end under the floor plate. It was not thought possible to fit a drain pipe from the cock owing to the cock being below the drainage level. To open the cock an ordinary box key and a loose toggle bar were used. When Brooks opened the cock on Friday, he dropped the toggle bar into the sump, and before the cock could be shut, the amount of water that had been blown out of the boiler was sufficient to bring the water level below the furnace crown. Nobody appears to have realised that the boiler was then in a dangerous condition in the event of the fire being lighted. On the following day the foreman had instructions to go to another branch of the business, and although the accident during the blowing down appears to have been known to all concerned, no steps were taken to restore the water level in the boiler. Work was commenced on Monday morning, the day of the explosion, at 8 a.m., and the fireman asked the stillman for the hose to fill the boiler. The hose was three-fourths of an inch internal diameter with an estimated flow of 120 gallons per hour, and the method of filling the boiler was by removing one of the safety valves and inserting the hose. The fireman states that he saw water in the gauge glasses at 8.30 a.m. when he proceeded to light the fire. The hose was running up to 9.20 a.m., when it was removed owing to steam being generated. He looked at the pressure gauge shortly after, which showed a pressure of 25 lb., and then started the feed pump, and put more coal on the fire. The foreman was in the stokehold at the time, and the fireman at about 9.40 a.m. proceeded to another part of the building. The foreman thought he could see water in the gauge glasses, and there is definite evidence that he looked at the water gauges as he had removed the protector from one to tighten a leaky nut. He then came out of the stokehold and said to the stillman that the water was low in the boiler. The explosion occurred immediately after. It is stated the steam pressure at the time of the explosion was 25 lb. per square inch.

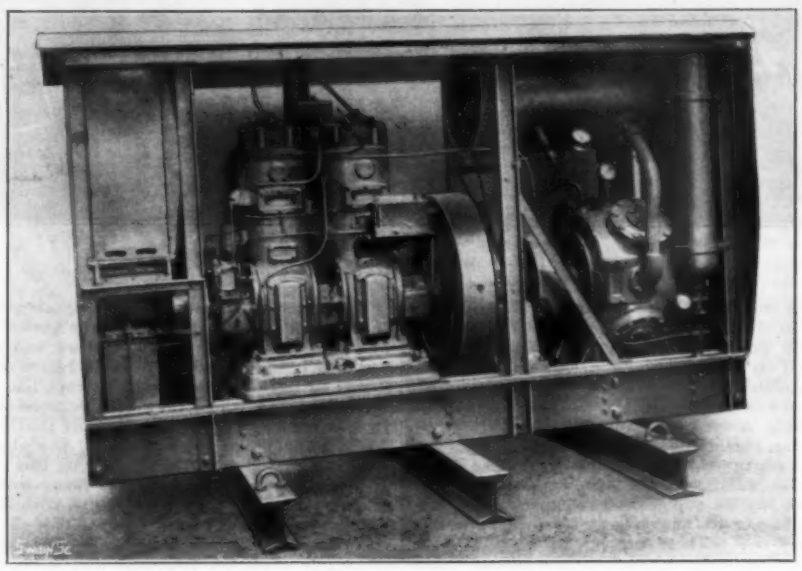
"After the explosion I tested the water gauges and found them in a satisfactory working condition.

"The firm propose to fit a blow down cock with a guard ring, so that the key cannot be removed unless the cock is closed, and the key is to be fitted with a toggle that cannot be removed. A fusible plug has also been fitted in the new furnace."

Air Compressor Sets for Bridge-Building Operations.

WE show in the accompanying engraving a front view of one of a number of self-contained oil-engine driven air-compressing sets, which have recently been constructed by Petters, Ltd., of Westland Works, Yeovil, for use in connection with bridge-building operations in India. Two sizes of units have been made, the smaller of the two being illustrated herewith. This set comprises a 24/28 B.H.P. Petter twin-cylinder surface ignition oil engine, designed to work on paraffin fuel, and to develop its full output at a normal speed of 525 r.p.m. It is coupled through a clutch to a Reavell quadruplex air compressor, having a designed capacity of 100 cubic feet of free air per minute, compressed to a working pressure of 100 lb. per square inch. In the larger set, the oil engine has an output of 36/42 B.H.P., and the air compressor a capacity of 175 cubic feet of free air per minute at 100 lb. working pressure.

The two plants are similar as regards their general arrangement. As will be seen from the engraving the engine and compressor are mounted on a built-up girder base, which carries a steel framed housing with removable light steel end and side plates. Below the bed-plate are three 8in. by 6in. rolled joists, which are drilled for attachment to the bridge girders and are furnished with shackles for the chain slings used when lifting. The girder base has an overall length of 10ft., with a width of 5ft. over the joist ends. The overall height of the set is 5ft. 6in. from the underside of the bed-plate, and the approximate height required for slinging with the lifting chains in place is 10ft. 8in., while the approximate weight of the set is about 3½ tons.



24-28 B.H.P. OIL ENGINE-DRIVEN AIR COMPRESSOR SET

The engine is of the Petter standard design, and the cylinders are equipped with the firm's patented cold-starting cartridge device. Provision is also made for air starting, and a special compressed air receiver is fitted for this purpose, which is charged at a pressure of 200 lb. per square inch by a small 1½ B.H.P. Petter air compresor set with a designed capacity of 3·75 cubic feet of free air per minute. At the left-hand end of the set there will be seen the radiator and fan, which is complete with an engine-driven circulating water pump. Below the radiator is the main fuel tank, and the fuel is lifted by low-pressure crank case air from this tank to the gravity feed fuel pots over the cylinder heads. Immediately over the main compressor is the air storage receiver, which is equipped with a pressure gauge, safety valve, and control valve. The clutch is of the Croft centrifugal type. As the sets we have described may be called upon to work in dusty situations, a special air filter is fitted on to the compressor suction.

THE advantages of a knowledge of first-aid to the employees of a large manufacturing concern need no emphasis. Some months ago it was decided to form a unit of the St. John's Ambulance Brigade from among the Prescot employees of British Insulated Cables, Ltd., and classes have been conducted with such success that at a recent examination every candidate passed the required tests. On Friday, November 2nd, certificates were presented to the members of the division by the managing director of the company, Mr. G. H. Nisbett, who complimented them upon their success and the keenness they had shown in their ambulance work. He said that such excellent results reflected great credit on their instructors, Miss S. Purdue and Mr. D. Pender, and on Dr. Orton, who had acted as lecturer to the classes. Mr. Nisbett then proceeded to distribute prizes to the successful students at the various day and evening classes. British Insulated Cables, Ltd., has for many years taken a keen interest in the technical education of its staff and workpeople, and gives considerable assistance in the matter of fees and travelling expenses, besides providing prizes for the encouragement of students.

Railway Matters.

We have had so much to say of late as to serious railway accidents that we hope not to have to refer to it again for some time. We would, however, as, we trust, a final word, like to refer to the attention that was drawn in the Press to there having been four serious accidents during October. Unfortunately, that was not unusual; there were five in October of last year, six in the November of 1926, and four in January, 1925.

An official statement covering the operations of the Canadian Pacific Railway for the nine months ending September shows net profits of 31,225,289 dollars, as compared with 25,495,245 dollars for the corresponding period of 1927. Working expenses were 125,342,909 dollars, as compared with 114,687,789 dollars, an increase of 10,655,199 dollars. The gross earnings showed an increase of 17,385,163 dollars.

A substantial increase in earnings is shown by the official statement of the Canadian National Railway for the first nine months of the current year. The gross earnings amounted to 196,318,822 dollars, as compared with 178,019,585 dollars for the corresponding months last year. The working expenses amounted to 160,231,024 dollars, as against 151,017,244 dollars, and the net earnings were 36,086,797 dollars, as compared with 27,002,341 dollars.

According to Sir John Pringle's annual report on the railway accidents of 1927, it appears that 200 servants were killed in "movement" accidents last year. Of those, only four lost their lives in coupling accidents, and 26 in other shunting accidents. On the other hand, there were 54 killed whilst working on the permanent way, and no less than 82, or over 40 per cent., when walking or standing on the line on duty or when proceeding to or from work. The number injured was 3177, and the two totals compared with an average for the previous five years of 206 and 3314 respectively.

A report issued by the Canadian Bureau of Statistics on the operations of Canadian steam railways in 1927 gives the total operating revenue of the fifty-three railways as 499,064,207 dollars. The total operating expenses amounted to 407,646,280 dollars. Out of the fifty-three steam railways, thirty-one showed deficits instead of net corporate income, while the total net corporate income with all these deficits deducted amounted to only 2,998,407 dollars. Increase in wages partly amounted for these deficits, but there was also a slightly lower freight receipt per ton mile as well. These more than offset any improvements in the operations during the year.

As an experiment, the London and North-Eastern Railway built, some two years ago, twenty-one open thirds, 60ft. long, in steel, and the weight came out at 34 tons 5 cwt. Similar coaches made of teak weighed 32¼ tons each. At the same time, thirty-four 60ft. vans were built to exactly the same overall dimensions as the wooden vans, the comparative weights in this case being 31 tons and 29 tons. Both these examples of steel coach construction can be regarded as representing the latest practice of British steel coach builders. Teak is one of the most expensive woods used in carriage construction; but carriage builders will supply a teak-built coach for less money than a steel coach of the same design, although the difference is not so great as it used to be.

Writing to *The Times* recently, Lieut.-Colonel F. Froom, who was the traffic superintendent of the East Indian Railway, makes the suggestion, in connection with the numerous railway accidents of late, that the best position for a driver to get a clear look-out is at the front of the engine. He says that it surely is not beyond the capacity of locomotive designers to give the driver of a fast train all his controls in a front cab, with duplicates for the fireman to work from the footplate in case of emergency. To that we would answer that the driving of a locomotive could readily be done from the front, but such an arrangement would have many objections, and whilst bringing greater safety in one direction would introduce evils not now experienced. The driver would, for instance, be robbed of the company and assistance of his fireman, and the driver might object to the greater danger of his position in the event of an accident. It has to be admitted that with the larger boiler of the present day and the low funnel, a driver has not as good a running view as he had. One wonders whether he could not be assisted by mirrors.

The opening out of tunnels on portions of line that are being widened is now no uncommon thing. One which was being so treated was the Cofton Tunnel on the Birmingham and Gloucester section of the London, Midland and Scottish Railway, which was 440 yards long. The cutting over the tunnel and at the sides was excavated and the tunnel was divided into lengths of above 50ft. by cutting chases through the brickwork across the arch from springing to springing, and cutting windows through the haunches at springing level on both sides. It was arranged that a length of 410ft. at the northern end should be dropped on Sunday, May 13th last. The windows were each about 4ft. by 2ft. 6in., and spaced so as to leave pillars about 3ft. wide between the windows. A light timber strutting was placed in each window in order to prevent the brickwork in the top of the window from falling, but this was not intended, and, in fact, could not give any appreciable assistance to the pillars in supporting the main body of brickwork of the tunnel arch. It is important to note that pneumatic hammers were used for the removal of the brickwork. On the afternoon of Friday, May 11th, all the chases had been cut in 350ft. out of the 410ft., and all the windows on the west side, and all but five on the east side had been made, when the 60ft. length on which the men were working suddenly collapsed. As a consequence, two railway servants and two contractors' servants were killed. Colonel Trench inquired into the accident, and his report thereon has recently been issued. He says that the method adopted was based on actual experience of those concerned, and all available information pointed to the soundness and strength of the brickwork concerned. It was clear that the structure was less sound than was expected, and, further, was unduly weakened by the cutting of such large windows by means of pneumatic hammers.

Notes and Memoranda.

In the log of the drilling of an oil well in Oklahoma, U.S.A., given in the course of a lecture to the Institution of Petroleum Technologists by Mr. G. Heseldin, there is the rather laconic entry: "Ran core barrel three times. Lost one day on account of boiler blowing up."

The amount of soluble oxygen present in steel appears, according to Mr. M. A. Grossmann, to affect the microstructure. The soluble oxygen diffuses readily, and is considered here apart from precipitated oxides and non-metallic inclusions. A high oxygen content seemingly favours solubility of cementite in alpha iron, and as a result of this solubility it affords opportunity for cementite to diffuse. In certain steels, cementite may occur not as pearlite, but as massive cementite associated with grains of ferrite. The separation of pearlite into massive cementite and ferrite appears to be due to diffusion.

One of the ball mills of the experimental station of the American Bureau of Mines for investigating tin ore grinding has been arrangod so that the balls may be seen in operation when working alone. To do this the solid end plates of the mill are replaced by coarse-mesh screens. The circular paths and trajectory paths may be observed. Examination makes it obvious that the balls in the inner circular path do but little work. The critical speed when the balls cling to the circular path by centrifugal force may be definitely determined. Many other co-ordinates may be located. The arrangement will permit the taking of moving pictures.

The following story is contributed by W. E. Elam to the "Proceedings" of the American Society of Civil Engineers:—A particular stretch of the Mississippi River, known as the Greenville Bends, consists of many loops and curves continually doubling one on the other. So an Indian started at one of the lower bends and floated down stream until he came to the narrow neck separating him from the next loop up stream. A "carry" of a few hundred feet brought him to a higher reach of the river. The operation was repeated again and again—floating down; carrying over; floating down; and carrying over. Thus, by floating down stream 16 miles and carrying his canoe across a few portages on foot, he was 45 miles farther up stream than when he started.

The results of experiments carried out by the American Society for Steel Treatment have shown that almost any desired range of cooling rate, for the quenching of steel, between those of oil and water, can be attained by the use of glycerine water solutions of various concentrations. The cooling rate of steel decreases continuously with the addition of glycerine to water, and more rapidly as the percentage of glycerine is increased, pure glycerine being slightly below oil; hence glycerine and water solutions effectively bridge the gap between oil and water. At lower temperatures glycerine-water solutions give a much more rapid cooling rate than oil. Hence the possibility of choosing a glycerine-water solution which will harden no deeper than oil, and yet cool through the lower temperature range more rapidly.

A paper on "Electric Furnaces for Heat Treating" was delivered recently before the American Society for Steel Treating by Mr. A. N. Otis, who stated that the object of his paper was to show the present status of electric furnaces, the extent of their use for heat treating, and some new types which had been developed recently. Rapid increase in the use of electric furnaces was shown by a list of the principal installations, some of the individual furnaces and their operation being described. Photographs were shown to illustrate the various types. Reference was made to specific applications, including furnaces for annealing tool steel bars and rods, and elevator furnaces for annealing sheet steel for electrical machines, the latter without the use of boxes. Large savings were shown by this method. Among new developments, electric furnaces for forging were referred to, also continuous furnaces for the new process of copper brazing.

The new standard type of Mezda lamp, which has as its most distinctive feature an inside-frosted bulb, is the result of a successful endeavour to improve the construction of incandescent lamps over the range of ratings that is suitable for domestic lighting and services of like calibre. To satisfy all the demands of good lighting, it was found necessary to have six different sized lamps in this new type, namely, 15-watt, 25-watt, 40-watt, 50-watt, 60-watt, and 100-watt. A number of improvements were made on the lamps during the process of simplification, so that it was possible to make the new type markedly better than the lamps they were intended to replace. The improvement that gave the new type of lamps their distinctive appearance was the method of frosting the bulb on the inside. Among the other improvements may be mentioned a reduction of bulb size and the coiling of the filament. This last improvement made it possible to reduce the number of supports and still keep the filament in place.

It is usually assumed, states the *Electrical World*, that a travelling wave or voltage pulse is materially slowed up, if not stopped, by an air reactance coil. Such coils have been used for many years in high-voltage circuits for this protective purpose. The current-limiting reactors in the buses and connections of power systems have in general a different purpose, but these coils also partake of the character of the protective coils to the extent that each is an air coil. That an air coil may of itself oscillate as the result of the impact of a steep wave form, and that such oscillation may result in greatly increased values of voltage, is now announced as the result of some recent work reported by Dr. Rogowski. The fact is not so surprising, since every electrical system may oscillate; but it is of great interest in that apparently it has not been shown before nor its importance as a danger appreciated. The experiments showing the oscillations in an air reactance under the impulse of a rectangular voltage wave have been made possible by the cathode-ray oscillograph, which is now extending our knowledge of phenomena of extremely short duration in so many directions. Under a rectangular impulse such a coil is shown to oscillate in, as it were, a wide loop of current in the centre of the coil, with two nodes at each end of the loop, and beyond, toward the ends, two loops of lesser amplitude and opposite phase.

Miscellanea.

The Chester Electricity Committee, which has been carrying out an ambitious scheme of rural electrification, has obtained the sanction of the City Council to seek powers to borrow £20,000 for further extensions in country districts.

The Canadian Steel Corporation, subsidiary of the United States Steel Corporation, announces that its wire mill at Ojibway, Ontario, will commence operations within a few weeks. Plants for the manufacture of steel fence posts and woven-wire fences are also stated to be nearing completion. The construction of the Ojibway plant on the Canadian shore of Lake Erie, opposite Detroit, Mich., was started about ten years ago, but building operations were stopped owing to post-war conditions.

Austria has recently been celebrating the birthday of Dr. Auer von Welsbach, the inventor of the incandescent mantle, who is now seventy years old. Although it was his researches on the rare earths that rendered Welsbach world-famous, he was responsible for many other inventions and was associated with the introduction of the osmium lamp and the ferro-cerium compounds which form the basis of the modern pocket lighter and other igniting devices. Dr. Welsbach is still actively engaged on scientific work in the research laboratories set up in his castle in Carinthia.

In connection with the Public Health (Smoke Abatement) Act, 1926, the Ministry of Health has suggested that smoke inspectors should be specially qualified by a course of training; and with a view to assist candidates who are preparing for the post of smoke inspector, the Royal Sanitary Institute has arranged a course of ten lectures covering various aspects of the subject. The sixth lecture of this (the third) series was given at the Institute on Monday, November 5th, by Mr. E. W. L. Nicol, Assoc. I.E.E., M.I. Mar. E., whose subject was "The Principles and Practice of Stoking."

The following statement made by the Stanton Ironworks Company, Ltd., will be valuable to public speakers: One ton of Stanton iron pipes means wages paid in England on "getting" and converting 8 tons of material. It takes 3½ tons of British iron ore, ½ ton of British limestone, and 2 tons of British fuel—namely, 6 tons of British materials—to produce 1 ton of British pig iron, and it takes over 1 ton of British pig iron to make 1 ton of Stanton pipes; 8 tons total, all conveyed on British railways. Every £100 spent on such pipes means over £75 paid to British workmen, most of which is paid directly by the company.

Production of motor cars in Canada for the first nine months of the present year totalled 202,652 cars, valued at 129,328,879 dollars, a gain of 25 per cent. in number and 23 per cent. in value over the output of 161,583 cars, worth 105,179,954 dollars during the same period last year. This year's output to date included 33,020 open cars, 120,470 closed passenger cars, 5226 trucks, 43,852 chassis, 35 taxicabs, and 9 omnibuses. The official figures of the Dominion Bureau of Statistics give Canada's imports of motor cars for three-fourths of the current year as 42,545 cars, valued at 36,435,206 dollars. Exports aggregated 54,562 cars, appraised at 23,752,638 dollars.

The number of furnaces in blast in this country at the end of October was 136, an increase of 5 since the beginning of the month. The production of pig iron during the month amounted to 543,600 tons, compared with 503,900 tons in September and 596,300 tons in October, 1927; the daily rate was thus 17,536 tons in October, compared with 16,797 tons in September. The production included 174,700 tons of hematite, 216,200 tons of basic, 110,800 tons of foundry, and 18,600 tons of forge pig iron. The production of steel ingots and castings in October amounted to 756,000 tons, compared with 718,600 tons in September and 699,000 tons in October, 1927.

We hear with regret from the Department of Overseas Trade that Mr. R. W. Matthew, C.M.G., Director of the Trades, Empire and Economic Division of the Department, died after a very short illness on November 8th. Mr. Matthew, who was only forty-nine years of age, joined the staff of the Department of Overseas Trade in December, 1917, after a successful career at the Board of Trade, where he had served as private secretary to four successive Presidents, Mr. Sydney Buxton (Lord Buxton), Mr. John Burns, Mr. Runciman, and Sir Albert Stanley (Lord Ashfield). His work at the Department of Overseas Trade will be well known to many of our readers, and especially to the Chambers of Commerce, with whom he was always in close touch.

Tenders will shortly be invited in connection with construction works at the port of Rosario, which form part of the scheme for the general improvement of the Argentine navigable rivers. The project includes dredging to at least 24ft. on the river Parana from San Pedro to Rosario; to 19ft. from Rosario to Santa Fé; and to 21ft. at Concepcion-del-Uruguay. Improvements at Rosario itself have also been decided upon. They include paving of all open spaces, erection of concrete retaining walls along the water front, with masonry breakwaters; automatic sweeping and flushing of streets and warehouse floors; construction of rat-proof warehouses; special rat-proof storage bins for bags, bones, &c.; and placing rat-guards on all lines and hawsers between vessels and docks.

A competitive examination for one or more appointments as Ship Surveyor under the Board of Trade will be held in London on January 22nd, 1929. The limits of age are from 25 to 40 years; the salary is from £300 to £500, plus bonus, which is at present £114 on a salary of £300. Every candidate must have been trained in the theory and practice of ship design, construction and repair for not less than five years, and have had not less than three years' practical experience thereafter. He must have attained a position of responsibility in a shipbuilding or ship repairing establishment, and must also possess a University degree in Naval Architecture or furnish other evidence of satisfactory educational attainments. Applications are to be made not later than December 7th, 1928, on special forms obtainable from Establishment Department (Mercantile Marine Branch), 20, Great Smith-street, London, S.W. 1.

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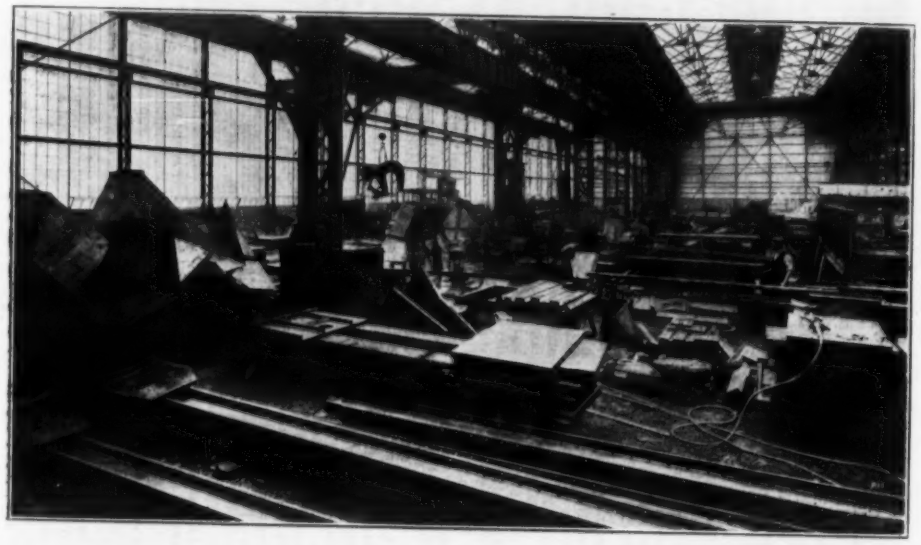

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TWO-PAGE SUPPLEMENT—PAPER MILL AND HYDRO-ELECTRIC POWER STATION IN NORTHERN ONTARIO.

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THE ENGINEER.

NOVEMBER 16, 1928.

Steel Railway Sleepers.

OWING to its depressed condition the steel industry is making great efforts to encourage the substitution of steel for other materials. Its success in that direction would be illusory if the increased demand for steel went to those foreigners who already send three million tons a year to this country. In the coming year the new Safeguarding Committee which is to be set up under the Board of Trade may lend a sympathetic ear to the demand, almost unanimous in the industry, for a protective tariff on steel; and that tariff may be sufficient to turn the scale in favour of patriotic purchasing. But to be on the safe side, the railway companies are at the moment the subjects of the solicitation of the industry. British railways purchase little or no foreign steel, and it may be taken as axiomatic that if they increased their demands, British manufacturers would get the orders. Hence the propaganda in support of steel rolling stock and steel sleepers. With regard to the former, we shall only say at the present time that to use railway accidents as an argument for steel coaches is a mistaken policy. It may provoke public clamour, but it will certainly provoke the railway companies in a different sense. The object of the companies is to prevent accidents altogether; not to employ or invent materials or designs which can withstand them. If the steel coach comes into wide use on surface railways, it will be for economic reasons, and not because of a superiority, which has not yet been conclusively proved, in the event of collisions or derailments.

The metal sleeper is an old device. Apart from light railways, on which it has been used from the early days of engineering, it has been employed extensively for main lines in India for something like forty years, and in other parts of the world for shorter periods. It is necessary in the Tropics because metal, cast iron or steel, is one of the few things the white ant can't eat. In Germany, many hundreds of track miles are laid on steel sleepers, but in this country, with the exception of a few experimental lengths, they are not to be found. There are, as far as we can discover, no reasons why they should not be employed, but, equally, there have been till the present no reasons why they should be. The wooden sleeper has proved entirely satisfactory, and it was at one time materially cheaper than steel. Moreover, it goes better with the chair, beloved of British permanent way men, than does the steel sleeper, which lends itself more kindly to the Vignoles or flat-bottomed rail. On the question of life, it is difficult to speak with certainty, but in all probability the steel sleeper is far superior. Treated hardwood sleepers have very long life records, up to forty-five years being known, but a good life of the ordinary British softwood sleeper in normal positions is between ten and twelve years. Steel sleepers, which have been in use for thirty-five years in India, are still good. As the weight of steel sleepers complete with chairs is little, if anything, greater than that of wooden sleepers in a similar condition, and as the life—save in obviously unsuitable positions—is probably two or three times as long, and as, moreover, the price to-day is very little, if at all, greater than that of creosoted softwood sleepers, there would appear to be a very good case for them. But there are two or three technical questions which must be answered satisfactorily before they can be accepted. In the first place, we may refer to the chair. It is very unlikely that British railways will give up the use of the chair, and its attachment to a steel sleeper is a matter of great importance. Assuming that the scantling of the sleeper is five-sixteenths of an inch, it will be seen at once that it does not offer much material at bolt holes to resist the load caused by the side pressure of the wheel against the rail. In time the holes might become enlarged, and the chairs would work loose. Various means of preventing this action are being tried, of which one of the most ingenious is casting the chair on to the sleeper. Tests of chaired sleepers so made are being conducted on at least one line in this country. Another problem is that of packing. Practically all steel sleepers are of channel or, as it is called, peas-pod shape, the ends being turned down in some way to prevent endways movement. Now, in packing a sleeper it is imperative to have the ballast well consolidated under the ends where the pressure of the rails has to be sustained, and to have little or no packing in the centre. At first sight, it would appear to be difficult to get the ballast under the ends at all, owing to the hollow formation, but experience has shown that this difficulty does not exist. The splaying of the sleeper has the effect of drawing the ballast in, and the greater trouble is to prevent it collecting under the centre, and thus causing the sleeper to rock. A third important point is the nature of the ballast. A corrosive ballast is clearly unsuitable, but the right grading of the ballast and the nature of the material to secure the best results have yet to be settled by prolonged tests. The railway engineer has often to take what ballast he can; not what he would like, and the treatment of it to suit hollow steel sleepers may have to be varied according to circumstances. But the greatest problem is that of chairs on steel sleepers, to which we have already alluded. It is really the crucial point. The experience of steel sleepers for flat-bottomed rails is so great that, as far as it is concerned, all the problems may be regarded as solved. But there is relatively little experience with chaired steel sleepers, and it is upon that important matter that their success or failure in Great Britain largely depends.

It is rather remarkable that at an interval of exactly ten years two Presidents of the Institution of Civil Engineers should have referred to this question in their presidential addresses. In 1918 Sir John Aspinall said: "The war has brought about such changes that we may wonder whether the immense difficulties of obtaining sleepers from the Baltic ports . . . will in the future cause any change to be made in the material used for our sleepers, and whether steel will in any measure take the place of wood. If the life of a steel sleeper is the same as that of a wooden one, the 300,000 tons of steel sleepers which would be required to replace the 4,500,000 wooden sleepers used each year by British railways would create a new steel manufacture for this country." Then, after touching upon the difficulty of attaching chairs to steel sleepers and the possible adoption of the flat-bottomed rail, Sir John said: "Such a proposition would add to the work of our iron ore miners, keep our blast-furnaces going, find employment for rolling mills, and continuous and steady work for some classes of labour after the war."

Only last week Sir Brodie Henderson, speaking in the same room, said : " In these days of severe competition, every effort must be made to carry freight as cheaply as possible. The permanent way has been improved, but it seems a great pity that in this country foreign timber sleepers are employed. If prejudice could be overcome, and steel sleepers employed, a very safe road would be provided and many tons of steel would be used per annum, giving much-needed work to our steel manufacturers." These two quotations from men enjoying the highest reputation in the railway world show, at least, the directions to which thoughts are turning. Sir Brodie was perhaps wrong in ascribing the retention of the wooden sleeper to prejudice. Its use has been supported by good reasons, but once it is shown that there are even better reasons for using the steel sleeper, it will certainly be adopted.

The New White Star Liner.

Both public and professional interest has been excited by the additional details of the new White Star liner which Lord Kylsant, the chairman of the company, disclosed last week on his return from the United States. Until then our knowledge of the ship was limited to the fact that her gross tonnage would be about 60,000 and her length approximately 1000ft. Lord Kylsant now tells us that the latter figure is to be taken as between perpendiculars, so that the overall length of the " super-Olympic " will probably be at least 1050ft., thus exceeding by 94ft. that of the " Majestic," at present the longest ship afloat. While the port facilities now available at Southampton are understood to be adequate even for a vessel of these enormous dimensions, existing accommodation at New York will not suffice, and plans have therefore been formulated for the construction of new piers. This proof of the cordial relations which obtain between our great liner companies and the New York port authorities is very gratifying. While neither the beam nor the draught of the new ship has been revealed, it is reasonable to assume that she will be broader than the " Majestic," which has an extreme breadth of 100ft. Lord Kylsant's most interesting disclosure concerns the propelling machinery. The electric drive has been chosen, and the only point—though a most important one—that remains to be determined is whether the generators shall be operated by steam turbines or internal combustion engines. A decision is expected before the end of the year. Electric propulsion is, of course, no novelty. As far back as 1912 the United States naval authorities tried it in the fleet collier " Jupiter "—now the aircraft carrier " Langley "—a vessel of 12,700 tons, the turbo-electric plant being designed for an output of 7152 S.H.P. The experiment was very successful, so much so, indeed, that the " New Mexico," one of the 32,000-ton battleships authorised in 1914, was similarly equipped. Her machinery consisted of two turbine-driven generating units and four propelling motors, developing an aggregate of 27,500 S.H.P. The other ships of that year's programme, " Idaho " and " Mississippi," were driven by steam turbines with gearing. In this way it was possible to compare the performances of the two methods of drive, electric and steam. On her trials the " New Mexico " fulfilled every expectation. Not only did she prove more economical in steam consumption at all speeds than her sisters, but in facility of manœuvring and ease of control she was much the best of the trio. Encouraged by these results, the American Navy Department adopted electric drive for all its later capital ships, and there is no reason to suppose that they have had cause to regret the step.

So far the system has reached its highest development in the huge aircraft carriers " Lexington " and " Saratoga." Each vessel displaces 33,000 tons, and the machinery, which is by far the most powerful ever installed for marine purposes, develops 180,000 S.H.P. Defects in the turbine blading have, up to now, prevented either ship from attaining her contract speed of 34·5 knots, but speeds slightly over 33 knots have been reached with several of the turbine elements cut out. In view of these results, it is quite evident that the electric drive is a thoroughly efficient and reliable method of propulsion. Here we may interpolate the little-known fact that although the system has been developed mainly in the United States, it owes its inception to British enterprise, for the first electrically driven ship, the " Tynemount," was built on the Clyde in 1912. British shipowners, until quite recently, evinced little interest in the system, but in the last year or two it has come more into favour. On September 15th last was launched, from Alexander Stephen and Sons' yard on the Clyde, the 19,000-ton P. & O. liner " Viceroy of India," the first British passenger steamer of large dimensions to be fitted for turbo-electric propulsion. As the machinery of this vessel has been fully described in our columns, we need not say more about it here, beyond remarking that the directors of the P. & O. Company would not have adopted this system of drive had they not been thoroughly satisfied as to its merits. In the case of the gigantic White Star liner now building at Belfast, a bolder innovation may be impending, since it is clear from Lord Kylsant's statement that there is more than a possibility that the generators of this ship will be driven by internal combustion engines. In the absence of knowledge as to her designed speed, it would be idle to speculate on the power required from the prime mover unit. Nevertheless, even if we assume the moderate figure of 25 knots, it is obvious that the internal combustion plant would have to be of unprecedented power, and to that extent the machinery of the new ship would be experimental. For this reason the final decision of the White Star directorate will be awaited with keen interest by the engineering world. On a much smaller scale, the Diesel-electric system has already undergone extensive trial. Up to the end of 1927 more than seventy vessels had been equipped with it, including H.M. cruiser-minelayer " Adventure." The most notable example of this system to date is furnished by the tanker " Brunswick," recently built at Greenock by Scotts' Shipbuilding and Engineering Company for the Atlantic Refining Company, of Philadelphia. The " Brunswick " has a gross tonnage of 9200, and a deadweight capacity of 12,500 tons, and is propelled by a twin electric-motor taking current from generators driven by four fast-running airless-injection oil engines. It is a remarkable tribute to British engineers that all the electrical plant in this American-owned ship should have been ordered from a British firm.

By common consent, the main advantages of the electric drive are economy at varying speeds and flexibility of control. While the former does not appear to be of prime importance on the Western Ocean route, on which fast liners usually maintain a steady speed from port to port, the latter is unquestionably of great moment when a very large ship enters a crowded fairway and has to make her way through thronging traffic to a difficult berth. Everyone who has seen a big liner docking at one of the North River piers in New York will appreciate this point. We should not be surprised to learn that the personal experiences of White Star officials in these circumstances were a potent factor in determining the machinery equipment of their latest leviathan. Electric drive has the further advantage of enabling the underwater spaces of a ship to be more closely subdivided, thereby increasing the margin of safety. This is a consideration which has, we believe, always weighed heavily with the United States naval authorities, but it applies with equal force to the design of passenger-carrying ships. Other merits of the system which have a special appeal from a shipowners' point of view are the reduction of noise, as compared with a geared turbine installation, the avoidance of propeller racing in a heavy sea, and the almost complete absence of vibration. Whether these advantages would be present to the same degree in an internal combustion-electric ship can only be determined by actual test. There remains the question of speed, as to which few data concerning electrically driven merchantmen are as yet available. At the present time, a new competition in the trans-oceanic passenger services is developing. About six months hence Germany will put into service two new liners which will, it is claimed, make the run from Southampton to New York in five days. Should this promise be fulfilled, the veteran " Mauretania," which has held all speed records for more than twenty-one years, will have to lower her colours. Leaving aside the sentimental aspect of the question, it is obviously important from the commercial point of view that British liners should maintain their lead in regard to speed. It may be that the new White Star ship will establish a new record in this connection, for, as we have seen, two of the fastest ships in the world are electrically driven. There is, however, another Richmond in the field. The Cunard Company, with its long-standing tradition of speed supremacy, is believed to be on the point of ordering a new ship of the largest class, and it will indeed be surprising if this vessel proves to be inferior in speed to any rival so far built or projected, whether at home or abroad.

British Submarines: A German Criticism.

Our Berlin contemporary *Schiffbau* prints the following in its issue of November 7th :—

" On May 2nd, 1928, The Engineer published details of the British submarines of the ' O ' class. According to these details, the boats displace 1345 tons on the surface and 1805 below water. The armament consists of a 4in. and one smaller gun and eight torpedo tubes, torpedo armament thus predominating. It is surprising that, even in this class, the fighting power should be so feeble. Apart from the very low speed, which is absolutely inadequate for modern purposes, the single 4in. gun must be characterised as useless. In view of the low surface speed, even the value of the torpedo armament is very dubious ; moreover, for so large a boat, eight tubes with two torpedoes apiece are very few. The Engineer makes no mention of armour protection on the deck, sides, or conning tower. If we take the weight of the 4in. gun, with its ammunition, as being about 10 tons, and that of the tubes and torpedoes as 46 tons, we arrive at a total of some 56 tons as the weight allotted to military equipment. As the boat displaces 1345 tons on the surface, it follows that only 4 per cent. of the total displacement is devoted to offensive power ! This is such a meagre percentage that it really does not pay to build such an expensive submarine.

" Either the details given by The Engineer are inaccurate or submarine construction in the British Navy is extraordinarily behind the times. Nowadays in almost all great navies the surface speed of submarines is at least 20 knots ; the armament, with hardly an exception, comprises two to four 6in. guns, besides at least four tubes with eight torpedoes, while the sides of the external hull, the deck, and the conning tower are all well armoured. With such boats something can be done ; with boats of the British ' O ' class—if The Engineer's details are correct—practically nothing. Probably the latter carry the usual enormous mass of ballast to ensure stability, and this deadweight contributes nothing to the offensive or defensive power. It explains the extraordinarily small percentage of displacement—4 per cent.—assigned to military qualities, while in modern boats upwards of 20 per cent. is reserved for this purpose. For example, the details of an 850-ton boat for one of the Balkan Powers are as follows :—Surface displacement, 850 tons ; surface speed, 20 knots ; radius of action, 6000 miles at 10 knots ; armament, two 6in. 50-cal. guns, with 375 rounds apiece, and four 21in. tubes with eight torpedoes ; deck, sides and tower armoured with 30 mm. nickel steel. The respective weights of this equipment are :—Armour, 99·96 tons ; torpedo armament, 11·30 tons ; gun armament, 57·37 tons ; total, 168·63 tons, or about 20 per cent. of the surface displacement. Very different is the fighting power of such boats from that of the British ' O ' class, quite apart from their high speed of 20 knots, which is much superior to the British 15 knots. Great Britain, no doubt, has been successful in building battleships, armoured cruisers, light cruisers and destroyers, but in the sphere of submarine construction she has made many blunders, as witness the fiasco with ' X 1.' This failure on the part of British constructors in such an exceptionally important branch is incomprehensible. Are they incapable of breaking away from pre-conceived ideas ? If so, a drastic reorganisation to ensure a more prudent expenditure of public funds would seem to be indicated."

Had we not a shrewd suspicion as to the authorship of the foregoing article, we should judge it to have been written by someone whose knowledge of submarines and their design was rudimentary, to say the least. As it is, a few comments may be offered. In the first place the details we published were taken from the official " Return of Fleets," 1928, and related to the " Oberon." Later units of the " O " class differ from the prototype, the surface displacement having been increased to 1540 tons. With regard to the considerations which led the Admiralty to accept a nominally low speed for these boats, we could say much, but must refrain. Suffice it to mention that the British naval authorities have always developed, and are continuing to develop, the submarine as a purely naval weapon for legitimate naval use. German designers, on the other hand, are perhaps obsessed with the idea of the submarine as primarily a commerce destroyer. As the writer of the article can have no knowledge of the constructional features of our new boats, his sweeping judgment

of them is obviously valueless. It is also quite evident that he knows little of the current trend of submarine design abroad. His statement that almost all big navies are now building submarines with a minimum speed of 20 knots and an armament of two to four 6in. guns is demonstrably ridiculous, as he will find on referring to any naval annual. In fact, out of the hundreds of submarines now afloat or building, there is only a single boat with the characteristics named, and that is the British "X 1." The overwhelming majority of submarines built and building have speeds below 20 knots and mount no gun heavier than 4in. As for the boat alleged to be possessed by a Balkan Power, which has such wonderful powers of offence and defence, we confess to having never heard of it, and would be grateful for more specific information.

The German journal's strictures on the backwardness of British submarine design will doubtless be received in the proper spirit by those to whom they are addressed. But as regards questions of stability, *Schiffbau* has ventured upon delicate ground. In this respect the shortcomings of German-built submarines were notorious. In his paper on "German Submarines," read before the Institution of Naval Architects in March, 1920, Mr. A. W. Johns, R.C.N.C., said: "The 'U 117-126' and 'U 139' classes were on completion found to be deficient in stability. 'U 139' class are stated to have had 3in. B.G., and on first visiting Germany the Allied Naval Commission found that wood filling was being fitted in one of the class at the edges of the upper deck for a considerable length to increase the buoyancy and stability." Much more damaging evidence on this point can be quoted from German sources. In an interview published in December, 1923, no less an authority than Professor Oswald Flamm, reputed to be the foremost German submarine designer, made the following remarkable admissions: "The war was not far advanced before we found by experience that when we built submarines of a size above the normal, or tried to give them the protection of heavy armour against attacks from the air, or to place on board more than a very limited number of mines or torpedoes, to say nothing of long-range guns, we at once destroyed their stability. The larger submarines we built towards the end of the war often, in submerging, took a list to port or starboard of as much as 55 deg., which naturally played havoc with the nerves of the crew and sometimes led to disaster." Yet at this very time there were in service British submarines—*e.g.*, the "M" class—which carried enormous top-weights and yet enjoyed perfect stability.

The best commentary on *Schiffbau's* article is provided by some remarks made by Rear-Admiral Douglas Dent, R.N., who was then in command of the Submarine Service, at the Institution of Naval Architects' meeting when Mr. Johns' paper was read. Admiral Dent said: "It is interesting to note that during the war we built the largest submarine, the fastest submarine on the surface, the fastest submarine submerged, the submarine with the heaviest gun armament, and the submarine with the heaviest torpedo armament. Notwithstanding all this, the building of submarines in this country was almost a side issue, whereas in Germany it was a big national effort."

Literature.

Elements of Highway Engineering. By ARTHUR H. BLANCHARD, M. Am. Soc. C.E., and ROGER L. MORRISON, M. Am. Soc. C.E. London: Chapman and Hall, Ltd. Second edition. 1928. Price 18s. 6d. net.

ALTHOUGH a presentment of the elements of highway engineering made in the year 1915, when the first edition of this book was published, remains effective at the present time, important traffic developments have made it necessary to bring under close consideration much which was of relatively small importance thirteen years ago. The amount of traffic is so great and its intensity upon main roads so pronounced that roads and road systems can no longer be planned or developed in the earlier, liberal manner, giving assurance of ample facilities for traffic, or, on the other hand, be made and improved as occasion may demand. The former policy was reasonable when the cost of making a main road was less than a quarter of what it is now, and when useful minor roads could be made for what now seem trifling sums. Now, however, the close correlation of roads and traffic is an economic necessity. The policy of waiting upon the occasion served well enough when no road was ever used up to its full capacity, and the increases in traffic intensity were but slow; but it would fail in these days, when a road but recently made may be used by large numbers of vehicles, including very heavy units. While, therefore, the elements of the subjects are themselves unchanged, the information needed for their successful application must be gathered from a wider field of inquiry and must be more nearly quantitative. The future must be more carefully considered and none of the costly roads now necessary for main route traffic be so planned that in a few years they may become of minor importance, or be found to have been unnecessary. It is significant of the special importance of such considerations in relation to highways in the United States that Mr. Blanchard's designation as a consulting highway engineer is extended to embrace the term traffic control consultant, while Mr. Morrison is Professor of the combined subjects, Highway Engineering and Highway Transport, at the University of Michigan.

In order that it may be realised what were the problems confronting the authors in the preparation of this edition, it may be recalled that the first edition was written by Professor Blanchard at the request of several professors of civil engineering, as a text-book suitable for one-semester courses included in civil engineering curricula. Presuming that the present edition is intended to preserve that character, it will be realised that the book had to be limited, not by the criterion of quantity of matter, but, rather, by that of the time which would be needed to cover as much as necessary of the old ground and to deal aedquately with the new matter. Accordingly, as it seems, the authors have rigorously pruned the text and have reduced the number of illustrations. The 497 pages of the first edition have been reduced to 335, but the reduction in effective text is much less than the difference so expressed, for the number of illustrations has been reduced by some forty-four, representing perhaps more than twenty pages gained for text. Further, the suppression of the appendices represents a gain of about thirty-five pages, terminology being dealt with in the chapters, while, so the authors consider, readers may be referred to laboratory manuals for information relating to tests and physical properties of materials. It is explained in the preface that the book is rather a rewriting than a revision, several chapters having been completely rewritten.

The new matter includes a three-page introduction and a chapter on Highway Transport Surveys. In this useful chapter the authors have avoided the unconvincing methods of some American writers who seek to present the whole matter in balance sheet form. More wisely, Mr. Blanchard and Mr. Morrison have aimed at creating a basis for sound decisions as to the planning or development of a highway system, indicating where information is to be sought, how it is to be gathered and how used. They discuss the data needed in selecting roads to be included in a highway system, and furnish a list of questions to be answered, four of which relate to traffic conditions, and include: "What is the economic value of the roads, and will the returns justify the indicated developments?" They also explain the nature of the information needed respecting changes in population, migrations which may take place, and possible agricultural and industrial developments. Weight and size restrictions for vehicles are also discussed, and methods of collecting and recording traffic enumeration data. The necessary revision of allied subjects, in other chapters, has been effected; but in respect of methods followed in the making and maintaining of road crusts and carpets, no attempt has been made to bring the book up to date. No adverse criticism of that limitation would be called for were it not for the fact that what were then recent developments were somewhat carefully presented in the first edition, in which, indeed, there was much practical information relating to alternative methods of construction and maintenance, most of which is, of course, retained. Some of it, however, including paragraphs of considerable importance, has been discarded. Further, though the necessity for drastic pruning may be admitted, the reader might expect to find some references to quite important developments which have taken place since 1915, especially in respect of surface treatment, the uses of cold emulsion, and certain methods of crust construction or renewal not involving the use of bituminous materials.

The rewriting has been carefully done, and the book, with illustrations even better than those of the first edition, is excellently turned out.

As a text-book it is, no doubt, as well adapted as was the first edition for the authors' main purpose, but its further value as a well-written summary of practice is lessened by their attitude towards the contents, which they have in some degree treated as does the tree-pipit a young brood which includes a newly hatched cuckoo.

Agricola's De re Metallica. Newly translated into German by CARL SCHIFFNER. Berlin: V.D.I., Verlag. 1928.

IT might be thought that there was no room for another translation and reproduction of Agricola's famous treatise after the admirable work done some years ago by Mr. and Mrs. Herbert Clark Hoover, the very Hoover who is now elected President of the United States. But the American author rendered the old Latin into English, and the Germans wanted the text in their own language. Acting on the suggestion of Oscar von Miller, an Agricola Society was formed in connection with the German Museum at Munich. This Committee included representatives of the Verein deutscher Ingenieure and the Verein deutscher Eisenhüttenleute, together with Government and Provincial officials, and special representatives from the towns of Glauchau, Chemnitz and Zwickau with which Agricola himself was closely connected.

Apart from the difference in language the two volumes are very similar indeed, for in both the format of the original has been retained, and all the famous woodcuts have been reproduced as faithfully as possible on an antique-seeming paper. We understand that none of the Hoover blocks have been used, but that completely new blocks have been prepared for this edition. The reproduction is certainly admirable. Dr. Conrad Matschoss has written a foreword, and has throughout taken a close personal interest in the production. It will be recalled that the Hoovers found great difficulty with certain passages, as the meaning of some of the Latin words were obscure. We recently asked Dr. Matschoss if the German editors and translators had been able to clear up these doubtful passages, and we understood from him that they had not succeeded in solving the problems. We may congratulate Germany on now possessing a translation of Agricola of which it may be proud, and on the fact that a book which has been famous for more than three and a-half centuries is now accessible to the German public.

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Famous Trains. By C. G. Allen. Liverpool: Meccano Ltd., Binns-road. Price 2s. 6d. net.

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Bauvorschriften für Flugzeuge. Berlin-Adlershof: Deutsche Versuchsanstalt für Luftfahrt, E.V., Germany. Price 5 marks.

Aérologie et Aerodynamique. By E. Rothé. Paris: Gauthier-Villars et Cie., 55, Quai des Grands-Augustins, France. Price 50f. net.

The Economics of Coal Mining. By R. W. Dron. London: Edward Arnold and Co., 41, Maddox-street, W. 1. Price 10s. 6d. net.

Tin Companies' Position. Ninth edition. London: W. H. Rickinson and Son, 3, Great Winchester-street, E.C. 2. Price 2s. 6d. net.

Die Werkstoffe für den Bau Chemischer Apparate. By Dr. A. Fürth. Leipzig: Otto Spamen, Heinrichstrasse 9, Germany. Price 20 marks.

Handbook Encyclopedia of Engineering. London: Machinery Publishing Company, Ltd., 51, Chancery-lane, London, W.C. 2. Price 30s. net.

Die Misstände bei der Reichsbahn. By R. Hummel. Leipsig: H. A. Ludwig Degener, Hospitalstrasse 32, Germany. Price 2·50 marks.

Handling London's Underground Traffic. By J. P. Thomas. London: London's Underground, 55, Broadway, S.W. 1. Price 7s. 6d. net.

Les Routes Aériennes de l'Atlantique: Aperçu Météorlogique. By A. Baldit. Paris: Gauthier-Villars et Cie., 55, Quai des Grands-Augustins. Price 28f. net.

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Artificial Silk. By Ing. M. F. Reinthaler. Enlarged, revised and translated by F. M. Rowe. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 21s. net.

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The Application of the Mines (Working Facilities and Support) Act, 1923. *Part II., Minerals Under Railways.* By W. T. Lane and J. H. Roberts. London: The *Colliery Guardian* Company, Ltd., 30, Furnival-street, E.C. 4. Price 4s. net.

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Constant-Current Electric Driving on the "Austin" System.

In the early days of electric lighting, when series systems were in vogue, motors were run on constant-current circuits, but the regulating arrangements were crude, and the pioneers of those times had many difficulties to face. The advent of the shunt dynamo and motor, with the parallel system of distribution, was hailed as a welcome relief, and the series system was relegated to the background. Notwithstanding the general trend of events, Monsieur Thury, of Geneva, made a special study of the matter, and developed the scheme which bears his name. The Thury system was produced for the purpose of transmitting energy at high voltage, obtained principally from water power, and it still continues to operate successfully, although in the march of progress it is superseded by the present-day E.H.T. alternating-current schemes. The series system has the disadvantage that it is unsuitable for general distribution, a circumstance which has discouraged investigation of its possibilities, and diverted thought in other directions.

But whatever may be the position regarding public supply, the problem is modified in the case of a works or ship, where numerous motors are placed in a comparatively small area. In such cases it is possible to select certain motors and connect them in a series circuit forming a separate system. Recognising this, Gilbert Austin, Ltd., of Cathcart, Glasgow, has developed a new system, in order to take advantage of the underlying principle of variable voltage by connecting motors in series. The objective is to provide a motor having the qualities of the steam engine, which slows down to an overload and takes little or no steam from the boiler when stalled, and so to overcome the fundamental defect of the ordinary electric motor, which takes an excess current in an endeavour to maintain the speed. The system was designed primarily for ships, but is suitable for heavy loads on installations ashore, and is of special interest since several vessels are now being equipped with it, and the Orient liner "Orford," on which the first marine installation was fitted, has completed several voyages.

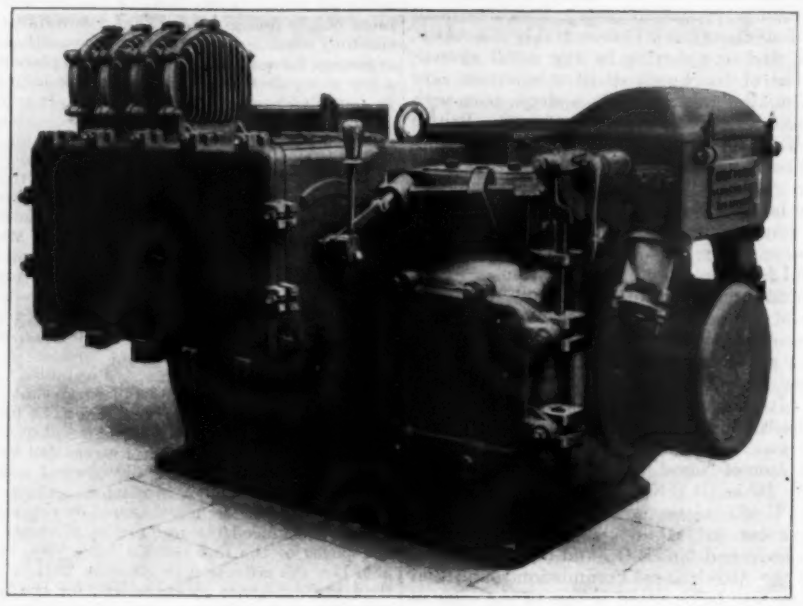


FIG. 2—CONSTANT-CURRENT MOTOR

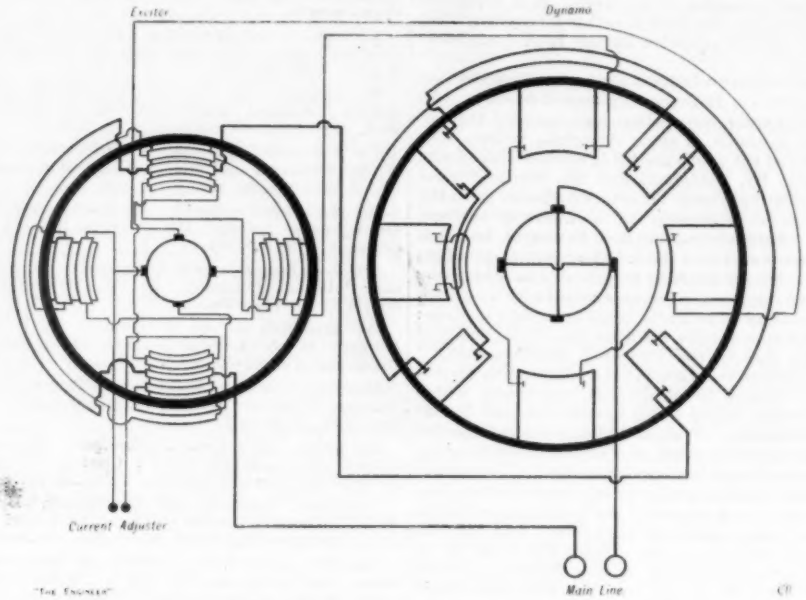


FIG. 1—GENERATOR CONNECTIONS

The standard line currents adopted are as follows :—

	Ampères.
(1) For installations up to 75 kW	125
(2) For installations from 75 to 150 kW	250
(3) For installations from 150 to 300 kW	500

It has been found that the 250-ampère circuit is the most convenient, and in cases where large motors are to be provided on the same system as those of smaller size the current from two 250-ampère generators may conveniently be combined to supply the 500-ampère circuit. Before describing the system, it will perhaps be advisable to give some of the leading features :—

(1) There are no fuses or circuit breakers.
(2) The motors may be run throughout the unusual speed range of zero to full speed, and may be switched from full speed on to full speed reverse, and varied in any desired manner without the slightest trouble or danger of damage to anything.
(3) The motor on a winch or windlass or capstan can hold the load stationary without the use of a brake, and with only a few volts demand on the generating plant.
(4) If a motor is overloaded it will slow down, and as it does so the voltage will fall and the load on the generator will be reduced. If the machine is overloaded until it stops, the torque will be a maximum and the load on the generating plant a minimum.
(5) In the case of plunger pumps, the discharge valve may be closed while the motor is running without damage to either pump or motor.
(6) Energy from descending loads is returned to the line and assists in raising other loads.
(7) Cable work is reduced to a single conductor connecting the motors in series.

It will be seen that the first five features correspond with those of the steam engine, and we understand that the claims have been substantiated in practice over a period of from three to four years. The system is claimed to be absolutely fool-proof.

Generator.—The dynamo is constructed on almost standard lines, and is separately excited by an exciter on an extension of the shaft. The principle will be understood by reference to Fig. 1. The primary excitation of the exciter is balanced by main line windings on the same poles, whilst armature reactions are balanced and compounding effects are obtained by means of an additional set of windings on the poles. The exciter is very rapid in action. The slightest fall in main line current will produce a change of flux in the exciter sufficient to increase the main field immediately, and to raise the voltage by the amount necessary to restore the main current to its full value. Similarly, any increase in the main line current is met by a similar action of the exciter, but in the reverse direction. The result is that the voltage varies up and down in almost a vertical line characteristic, while the current remains as steady as the voltage usually does in a direct-current machine of similar size.

Motor.—The motor—see Fig. 2—is a combination of a large and small machine on the same shaft. The large armature and small field are connected in series with the main line, while the large field and small armature are connected in series and shunted across the controlling resistance. The arrangement will be clear from the diagrams—Fig. 3—which show a reversing type controller. The by-pass switch is cam operated and short-circuits the motor at the "off" position. As soon as the by-pass switch opens, the current flows through the windings, as shown by the arrows, and gives rise to a small potential difference at the terminals of the controller resistance. This potential difference is utilised to shunt a portion of the main line current through the field circuit, as shown, and as it is variable the field current can be adjusted to any required value. The motor can therefore be made to run at any speed from zero upward, according to the voltage applied to the field, but in order to control the speed under varying load the small armature is connected to oppose the potential difference of the controller resistance. Consequently, at no load the speed rises until the voltage of the small armature is nearly equal to that of the controller potential difference, and the torque is a minimum, while with full load the speed falls and lowers the small armature voltage sufficiently to allow full load exciting current to flow in the field windings.

If overloaded until the motor stalls, the small armature gives no opposition voltage, and the maximum current from the controller passes through the field windings. The torque is therefore a maximum just as in the case of the steam engine, but the demand on the generator is a minimum, for, as the counter E.M.F. is wiped out, the pressure at the motor terminals is, say, 10 volts, including the potential difference on the potentiometer resistance, and the current being 250 ampères, the demand is

$$\frac{250 \times 10}{1000} = 2{\cdot}5 \text{ kW.}$$

The Line.—The simplicity of the electric wiring of the simple series circuit will be appreciated on comparing the two diagrams—Fig. 4—which show a cargo ship wired on the direct-current contactor system on the one hand and on the "Austin" system on the other. All that is

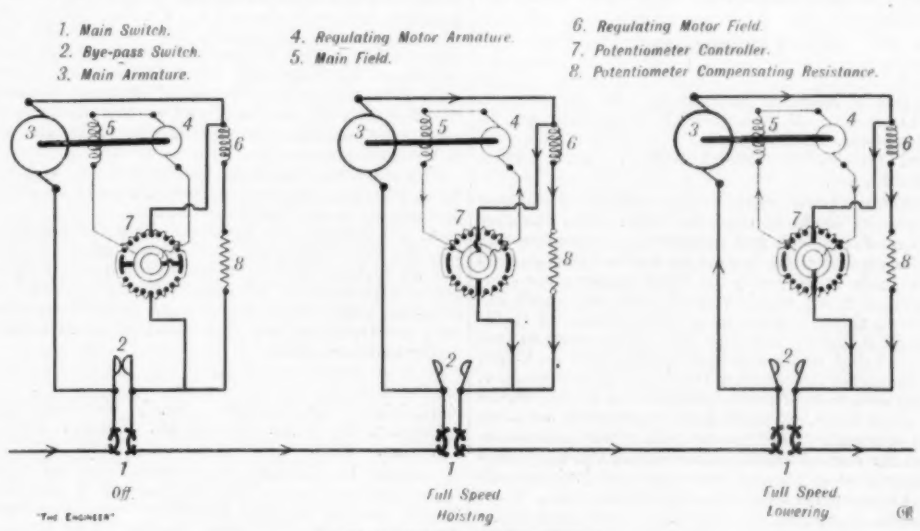


FIG. 3—MOTOR CONNECTIONS

necessary is to ensure that there can be no cable faults. For ship work a special type of cable has been designed, in which the primary insulation is lead sheathed, and insulated over the lead with a compound impervious to moisture. This is further protected with tape, steel armouring, and braiding, and impregnated in compound. The object of insulating the lead is to prevent electrolytic action between the lead and galvanised steel sheathing, and at the same time to provide secondary insulation for the system and a convenient test sheath for the conductor. This cable has been introduced by Gilbert Austin, Ltd., under the registered name of "Osmotite," which denotes that the cable is proof against osmotic action.

Reference may now be made to some examples typical of the system. The installation on the Orient company's t.s.s. "Orford" consists of two motor generators with a switchboard, as shown in Fig. 5; a double motor windlass with two capstans, Fig. 6; and six double winches, Fig. 7, each with two motors, making twelve winches in all. The equipment forms a small separate installation at the forward end of the vessel where the heavy cargo is stowed. The generators are each designed for an output of 250 ampéres, with voltage varying from zero to 300, according to the load. The switchboard seen in Fig. 5 is to be regarded as a novelty on board ship. The few simple switches required are contained in a steel cubicle, and are operated by the handles shown. On the enamelled steel front of the board the circuit diagram is traced in aluminium strip, and the switches carry discs with aluminium quadrants corresponding to the fixed strips, and so arranged as to present on the face of the board a diagram of the actual connections made by the switches. It will be observed that on the right-hand side of the board the main connections are crossed. This is done in order to arrange the dynamos and motors in alternate series circuits. Assuming the winches and windlass to be working together with the two dynamos in series, the current generated by the port dynamo would pass through the winch circuit, where its voltage would be reduced to approximately zero. The same current, however, would pass through the starboard dynamo, and have its voltage boosted up to the requirements of the windlass, and thus the maximum voltage of the system would correspond to that of the circuit having the heaviest load for the time being. Automatic arrangements are provided whereby in the event of one generator being inadvertently shut down while operating in series with the other machine, the standing generator is cut out of circuit and the running generator picks up the load without any disturbance. Referring to the motors, the main switches are interlocked with the controller and commutator doors, and can only be placed in the "on" position when the doors are shut, and with the controller in the "off" position. A drawing of the motor is shown in Fig. 8. The entire absence of sparking at either controller or brushes is a notable feature. Sparking cannot take place at the controller because of the exceedingly low pressure —5 to 10 volts—which is provided at the sliding contacts for excitation purposes. Sparking does not take place at the motors, because the armature and interpole current is constant, and the armature cross flux can never be pushed beyond the correcting capacity of the interpoles. The reason the system is flexible and free from disturbance, irrespective of the drastic nature of the work performed, is that movement of the controller is followed by the building up of a low potential in the motor fields, which, in turn, builds up a magnetic flux in the poles. This produces a change of counter electromotive force in the motor, which tends to alter the line current; but this alteration of line current has the effect of altering the flux in the exciter, which immediately produces the desired change in voltage. These changes, acting in sequence through the medium of magnetic flux, produce a cushioning effect.

Windlass.—The value of the system when applied to a windlass is attributable to its stalling and unloading qualities, and it is interesting to watch the load on the generator decrease while the pull increases as the motor hauls the anchor out of the mud, and to see the anchor pulled into the hawse pipe and held there with the brakes off and with only a nominal load on the generator.

Capstans.—For capstan work the pull can be applied in a flexible manner, without jerk or overstrain, and can be maintained with the armature stationary.

The pull and speed will adjust themselves to the load.

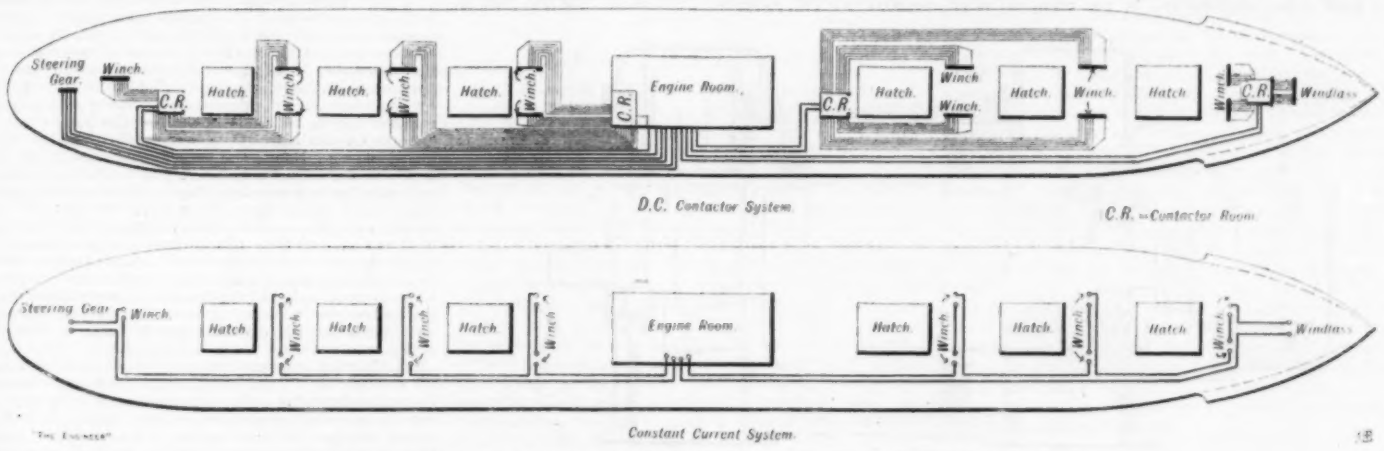


FIG. 4 WIRING DIAGRAMS FOR PARALLEL AND "AUSTIN" SERIES SYSTEMS

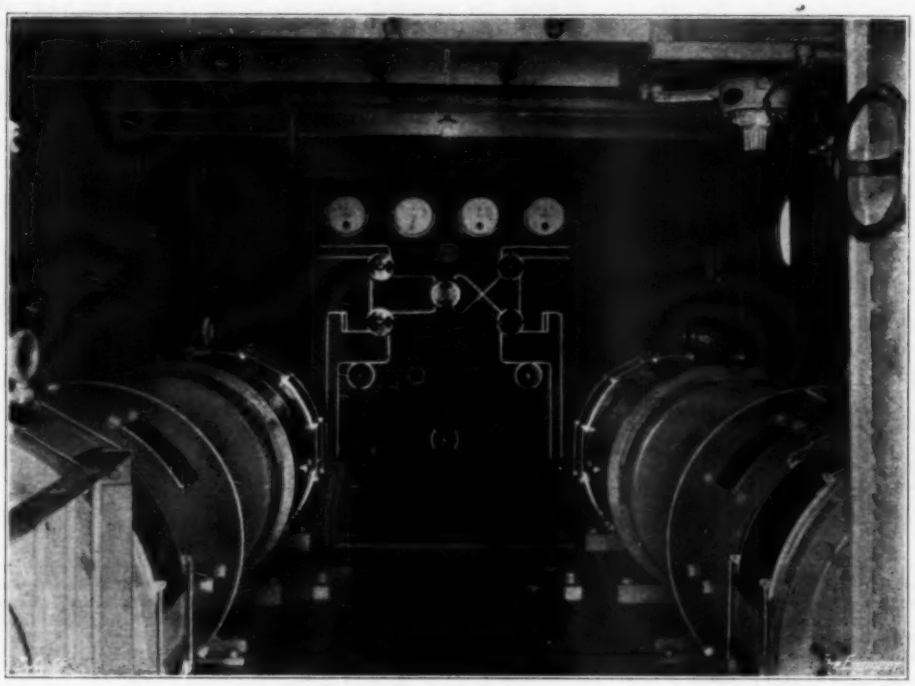


FIG. 5—MOTOR GENERATORS AND SWITCHBOARD

FIG. 6—WINDLASS AND CAPSTANS

FIG. 7—DOUBLE WINCHES

The speed can range from zero to six times full load speed, and there is no change-speed gear. The torque range is also great and infinitely variable. The fact that the load on the generator goes down as the pull increases, means that a great many capstans can be run from one small

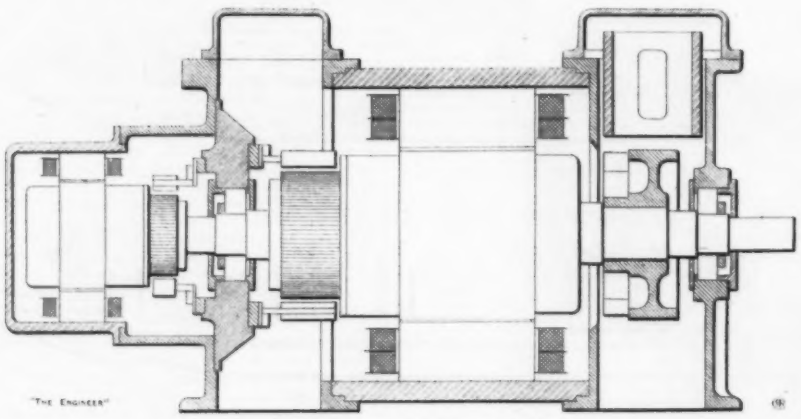


FIG. 8—SECTION THROUGH MOTOR

generator. Three years ago the system was adopted by the Admiralty for some 20-ton capstans at the Portsmouth Dockyard, and an additional set of capstans was recently put into service. In taking a battleship into dock, the clearance between ship and dock walls is often very small, and during high winds there is grave

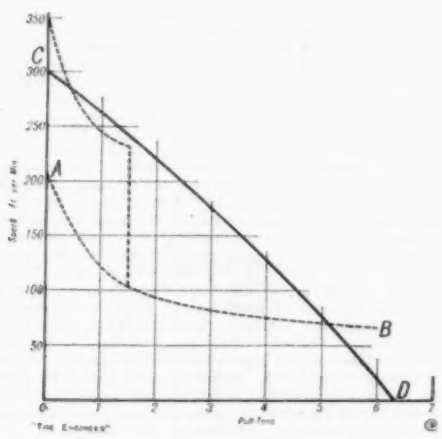


FIG. 9—MOTOR CHARACTERISTIC CURVES

risk of damage. As soon as a rope is made fast, not a moment must be lost in pulling in the slack and holding the vessel steady and it has been found that the "Austin" capstan is particularly suitable for this work since it can retard a rope in a flexible and easy manner. The docks are usually provided with six 20-ton capstans, two at the entrance, two at the head and two in the centre. The capstan will pull the vessel into the dock with the correct strain necessary to move the huge mass at the speed it should naturally travel through the water, whilst the rear capstans will effectively control the movement as the waters surge round the stern of the vessel. In doing so they return energy to the line. When the vessel is in dock the four or six hawsers can hold the ship firmly, all pulling hard against each other, and the load on the generator only amounts to about 25 kW, including line losses. The ship can be moved a matter of inches in any direction, and held stationary while the shores are placed in position, with even less load on the generator.

Winches.—The system makes a marked change in the operation of winches. As the motors have the same qualities as the steam engine, they are able to break the

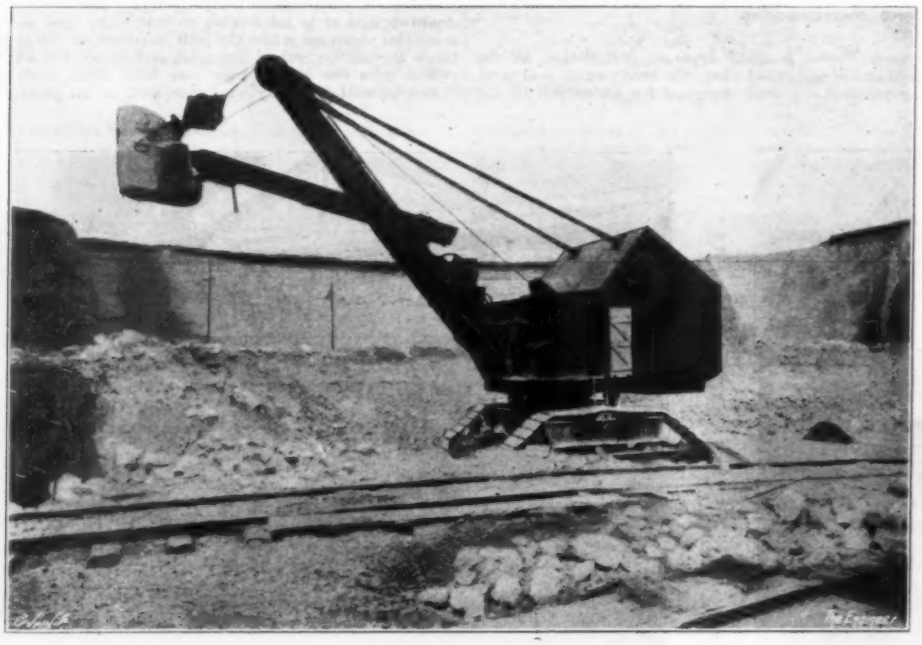


FIG. 10—ELECTRIC NAVVY

cargo out of a hold with very small loads on the generating plant, and with freedom from vexatious stoppages. The system also solves a problem of union purchase working which has hitherto been a difficulty. This will be appreciated on referring to the curves in Fig. 9. The dotted curve A B shows approximately a characteristic curve of a direct-current series motor, whilst the curve C D relates to an Austin motor The former is quite suitable for lifting heavier loads, but for the lighter loads and light hook the speeds are much too slow. Accordingly, it is usual to have an automatic discriminator, which, on the current falling below a predetermined limit, to which the discriminator is set, diverts the field circuit and jumps the speed to a similar curve in a higher position. The disadvantage of this arrangement is that the winch operator cannot run his winch slowly when he wishes to do so, because he has no control over the discriminator, which comes into play automatically below a given load. Similarly, when two winches are working together on the union purchase system, the automatic discriminator interferes seriously with the operation. If, for example, a load of 32 cwt. is to be lifted by one winch, it will operate on the lower curve, but the transfer winch, which is hooked to the same load, will operate on the high curve, and while the load will be raised at, say, 100ft., the transfer winch will run up to 300ft. or thereabouts, and will pull in the slack rapidly, and take the load over from the loaded winch. As soon as this change takes place, therefore, the transfer winch drops to the lower curve, while the first winch rises to the high curve, owing to the automatic discriminator over which the operator has no control. The result is that the load is zigzagged up the hatchway, and is liable to damage. Even in working light loads on the union purchase system, the pull on the two ropes varies during the transfer period, and the automatic discriminator is liable to come into action and interfere with the operation. The makers claim that the constant-current system introduces a motor with a curve of even acceleration, and one which can be varied through a wide range, the result being that loads can be operated as perfectly on this system as with the steam winch. Another aspect of these speed curves is that medium loads are lifted at much higher speeds than on the usual direct-current system, and it does not appear to be necessary to arrange for the light hook speeds to be so high as in the other case.

Electric Navvy.—The excavator is another machine on which the system shows up to good advantage, and Fig. 10 illustrates a navvy built by Sir Wm. Arrol and Co., Ltd., and equipped on the "Austin" system. It has been operating successfully for about a year and a-half at a

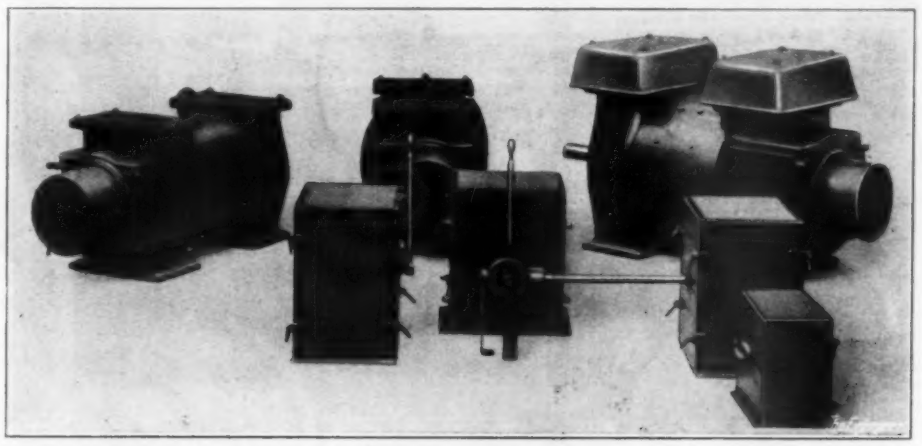


FIG. 11—MOTORS AND OPERATING GEAR FOR ELECTRIC NAVVY

chalk pit in Sittingbourne, Kent. The dynamo is a 100 kW machine, and is driven by belt from the works shafting. The constant current of 250 ampères is conveyed through a three-core solid rubber-sheathed flexible

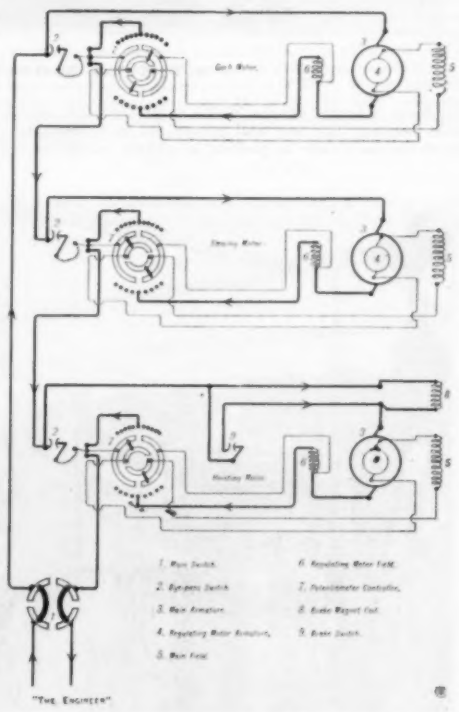


FIG. 12—CONNECTIONS FOR ELECTRIC NAVVY

cable to the excavator. Two cores are used to carry the constant current, and the third core for earthing the navvy structure. There is one motor for the hoisting motion and one for slewing, operated by a universal handle, as shown in Fig. 11. The other motor operated by a separate

handle is for the racking motion. The hoisting motor is a 100 H.P. machine; the slewing and racking motors each develop 70 H.P. A diagram of connections is shown by Fig. 12.

Dredgers.—The system is also applicable to dredgers, including tin and suction dredgers. In the bucket dredger the torque-limiting and unloading features are the attraction. The suction dredger is a peculiar case, in which the important matter is that the supply must not be cut off by overload, for should the dredger be discharging through a long pipe line, any stoppage would allow the solid matter to settle in the discharge pipe, and render it necessary to clear the obstruction by manual labour before resuming operations. It is this circumstance which has prevented the adoption of electricity for suction dredgers, but the constant current system should overcome the difficulty.

That this system of electrical operation is the solution of certain problems there seems to be no doubt, and the question arises as to what extent it will be adopted in industrial undertakings. The fact that separate generating plant and cables are required, and that the motor groups are limited by considerations of current and pressure, are disadvantages. The first cost must also necessarily be considerably greater than that of ordinary motors, for the motor consists of a combination of two motors, and the copper section must be large enough to carry full-line current all the time a motor is in circuit. In addition to this, there is the generating or converting plant, which, in view of the low flux densities necessary, is more costly in material than ordinary plant of similar output. Notwithstanding these considerations, the system has been adopted on a sufficiently extensive scale to test its reliability, and the duty obtainable from the machines is claimed to outweigh the disadvantages.

The bugbear of an alternating-current electricity supply is lagging current, and it would appear that where the constant-current system is adopted for part of the load on an alternating-current system, it can render useful service to the parent supply when the generator is driven by a synchronous motor, by assisting to correct the power factor.

SPALLING OF REFRACTORIES IN OIL-FIRED FURNACES.

It has been the common experience of those using fuel oil for firing boilers that the refractories of the furnaces fail because of spalling, rather than from slagging, whereas slagging is the more common trouble with furnaces fired with powdered coal. The relatively small amount of slagging in oil-fires furnaces is to be expected because the ash content of fuel oil is less than one-tenth of 1 per cent., whereas that of coal may be from 8 to 18 per cent. There has been, however, no proved explanation of the very common breaking up of the refractories walls by spalling, although that of strains caused by temperature variation has seemed the most reasonable one.

The Boiler Furnace Refractories Investigation, which the United States Bureau of Mines has been conducting in co-operation with the American Society of Mechanical Engineers, has included a study of furnace conditions of two large boilers using Illinois coal and one using fuel oil. The low fusion temperature of the ash of the coals made slagging a serious cause of trouble in the coal-fired furnaces, whereas the oil-fired furnace showed the usual failures from spalling. A special comparative analysis was made of the measurements taken in the coal and oil-fired furnaces in the attempt to elucidate the reason for the greater spalling.

The rate of heat liberation in the oil-fired was much higher than in the powdered-coal furnaces, but the maximum temperatures of the gases observed were the same, 2800 deg. Fah. The maximum temperatures measured were somewhat higher in the oil-fired furnace at the positions where the flame impinged on the wall. The temperature gradient plotted for the first 6in. of the hot side of the furnace wall under approximately constant operating conditions was not greater for the oil-fired than the coal-fired furnace.

The rate of change in temperature of the furnace walls when the furnaces were banked or fired up were nearly the same. The rate and frequency of change of temperature during steaming were not greater in the oil-fired than in the powdered-coal furnace walls. These measurements were taken at ½in. and further from the hot surface, and although they do not predicate the possibility that the small temperature variation at the hot surfaces of the walls were not the same, yet there is not sufficient evidence to warrant the acceptance of change of temperature as the only cause of the greater spalling in the oil-fired furnace, and differences in some other factors may be expected.

The chemical composition of the ash of the fuels and of the slags from the walls differed materially in that those from the oil-fired station were higher in sodium and lower in iron and calcium. The softening temperatures were low for all. Microscopic examinations of the slags by the Columbus Station of the Bureau of Standards have shown the presence of a mineral in the oil slag not previously found in coal-ash slag which has been identified as a sodium calcium silicate. It is therefore possible that some mineral or minerals formed in the slag, or in the combination of slag and brick, which was sensitive to thermal shock. Or the mineral may have had a very different coefficient of thermal expansion than the brick, and fracture resulted from the difference in the contraction of cooling. The relatively deep fractures found on the side and front walls bear out the former conception, and the thin fractures on the bridge wall, the latter.

THE JUNIOR INSTITUTION OF ENGINEERS.—At the forty-seventh annual general meeting of the Institution, held on Friday, November 9th, Mr. S. H. Hole, A.M.I.A.E., was elected Chairman of the Institution; Mr. S. Dunlop and Mr. E. D. Gill, Vice-Chairmen; Mr. R. H. Allen, B.Sc. Eng., Mr. F. C. Moore, Mr. G. A. Ogden, and Mr. E. T. Agutter, Councillors; and Mr. W. M. Hurrell, Treasurer of the Institution. The opening meeting of the forty-seventh session will be held at the Royal Society of Arts on Friday, December 7th, when the medals and awards will be distributed by the retiring President, Sir Murdoch MacDonald, K.C.M.G., C.B., M. Inst. C.E., who will also induct as his successor Lieut.-Colonel J. T. C. Moore-Brabazon, M.C., and the latter will deliver his address, entitled "The Future of Coal in Relation to Industry."

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

PATENT LAW REFORM.

SIR,—I should like to make two suggestions with reference to patent law reform, which are considerably more drastic and far-reaching than those—excellent though they are—in the recent report of the British Science Guild.

As things are, a patent merely gives you the right to defend a certain position—of which the strength is an unknown quantity—against all comers. And if the patent is a good one, they will come. It is a serious reproach to the law that every owner of a valuable patent should have to spend thousands a year in litigation to uphold it. The way of the infringer is far too easy. I propose first, that a patent once granted should be recognised as good, so long as the requirements as to fees, &c., are complied with; and that it should not be open to anyone accused of infringing it to impugn the validity; the question at issue should simply be, has he infringed or not. Secondly, a clear case of infringement should be made a criminal offence. Why not? It is a form of stealing.

C. F. DENDY MARSHALL.

Guildford, November 10th.

A CONDENSER PUZZLE.

SIR,—I find in your issue of November 2nd last an article in which it is sought to explain the fact that it is possible to withdraw from a condenser condensed steam at a temperature higher than that corresponding to the vapour tension of saturated steam at the same vacuum as that in the condenser.

A personal experience of my own enables me to offer an explanation.

When I was an engineer in the French Navy I had occasion, some thirty years or so ago, to make a curious experiment on an old torpedo boat. I withdrew more than half the upper tubes from a condenser so as to give a saw-tooth

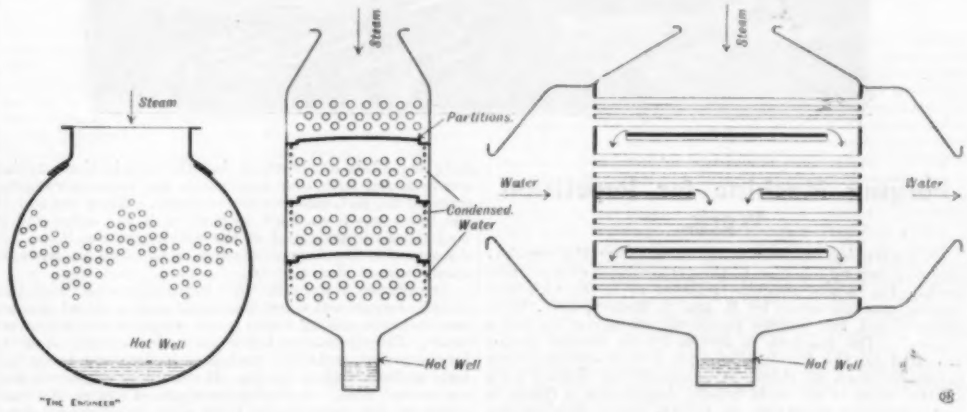


FIG. 1—MODIFIED CONDENSER

FIG. 2—PROPOSED FORM OF CONDENSER

arrangement—see Fig. 1—which would considerably increase the condensing surface that was struck directly by the steam. In addition, I removed a large number of tubes from the lower part of the condenser in order that the water condensed in the upper tubes in falling to the bottom of the condenser might not impinge, successively, upon a number of rows of tubes below them, but only on a few rows. The results were surprising. At low velocities the condensed water was at a temperature of from 60 deg. to 70 deg. Cent. when the vacuum in the condenser was normal. When I attempted to increase the velocity the vacuum in the condenser only fell slightly, but because of the high temperature of the water my pumps ceased to operate and I could not carry the experiment further. I replaced the tubes that I had removed and let the matter rest.

After consulting with my colleagues on these paradoxical results we came to the following conclusions:—

At the moment that the steam leaves the low-pressure cylinder of a triple-expansion torpedo boat engine it is at a pressure which is many hundreds of grammes above that in the condenser. Let us say that it is at a temperature T which is much higher than the temperature t of saturated steam at the condenser pressure. This steam expands in passing from the cylinder to the condenser, but when it encounters the tubes of the condenser it is still at a temperature—say, T_1—which is higher than t.

On contact with the tubes this steam is condensed, but the condensate remains at the temperature T_1, because it immediately falls below the tube. If, then, matters are so arranged that in its descent the condensate is not made any colder by coming in contact with any further tubes on its way down to the bottom of the apparatus, it will arrive there at a temperature T_2, which is still much higher than the temperature t.

The important fact which is generally overlooked is that when you condense steam you only remove its heat of vaporisation. The difficulty is to prevent the condensed water from touching further tubes in its fall. If you succeed by a suitable arrangement of the tubes in realising that desideratum, you will have in the hotwell water at a temperature T_2, which is higher than t, provided that T is higher than t, as it is in the case of reciprocating engines.

Such a condenser might be designed by dividing it up by means of horizontal baffles so as to form compartments not containing more than three or four rows of tubes—see Fig. 2. By adopting the Ginabat arrangement, the operation of which is explained by what I have just said, there would be found at the bottom of the condenser water which, flowing over the horizontal baffles, would arrive at the hotwell at a temperature T_2, which would be very much the same as the temperature T_1 of the steam as it entered the cylinder. It would suffice, in order to maintain the vacuum at the bottom of the condenser, to arrange above the level of the water collected in the hotwell, several rows of tubes which would continually condense the steam that tended to rise from the surface of the condensate and, hence, to destroy the vacuum in the hotwell. It was that which I had done in the torpedo boat condenser.

I have never had the time nor the opportunity to carry this idea further, but I should be pleased if any builders of condensers, on reading this in your widely circulating journal, would build and test this new type of condenser. I never patented it.

PAUL CONTE,
Ancien Ingénieur de la Marine.

Paris, November 10th.

SIXTY YEARS AGO.

WHO invented the bowstring girder? We do not know whether the Americans still claim to have done so, but sixty years ago, if we may judge from the evidence of our own columns, they certainly seem to have advanced that claim along with claims to "many other inventions to which they have really very little right." So far as the bowstring girder is concerned, we supplied in our issue of November 13th, 1868, fairly definite evidence that it was a British invention. In that issue we reproduced in facsimile a drawing by Alexander Nasmyth, signed and dated 1796, showing designs for bowstring bridges. In one case the design was for a bridge of 90ft. span, and in another for a bridge of 300ft. span. That the designer based his ideas on the bowstring principle is clearly shown by the fact that at the head of his drawings he placed a sketch of a bow and string and some diagrams showing the working of his mind in applying the fundamental stress system of a bow and string to a bridge girder. Alexander Nasmyth was the father of James Nasmyth, the inventor of the steam hammer. He was born in Edinburgh in 1758, and died there in 1840. He was not an engineer, but an artist, at first specialising in portraiture and later in landscape painting. Incidentally however, he was employed by noblemen on the improvement and beautifying of their estates and as an architect. As a bridge designer his achievements seem to have been confined to the design of the Dean Bridge, Edinburgh. It is evident from his sketches for a bowstring bridge that with his great talents as a painter he combined the essential instincts of an engineer. His abilities as an artist were inherited by his eldest son Patrick, while James, his youngest son, acquired his engineering abilities. . . . James Nasmyth's name is also mentioned in the same issue in another connection, namely, as a witness before the Trades' Union Commissioners, a body then inquiring into the alleged harmful effects of the trade union movement on the country's prosperity. Other witnesses before the Commissioners at the same time were Mr. John Robinson, of Sharp, Roberts and Co., Atlas Works, Manchester—subsequently Sharp, Stewart and Co., Atlas Works, Glasgow—and Mr. C. F. Beyer, of Beyer, Peacock and Co., Gorton Foundry, Manchester. Mr. Beyer migrated from Saxony to Manchester in 1834, and for a time was employed at Sharp, Roberts' works. His evidence was to the effect that Germany was rapidly outstripping us in the manufacture of locomotives. About 1838 the Borsig works at Berlin began to build locomotives, but were forced to use straight axles because they could not make cranked axles. Subsequently so much progress was made that in 1868, when a really good axle was required, British builders were obliged to send to Germany for it. No mention was made of Mr. Nasmyth's evidence, but Mr. Robinson's was given in some detail. According to Mr. Robinson, France, Germany and Austria were not only supplying their own locomotive requirements, but were competing against British builders in Russia, Spain, Italy, Egypt, India, and even England itself. In 1865 the Great Eastern Railway Company ordered forty engines from Schneider and Co. Fifteen of these engines had been delivered and the railway authorities reported that in workmanship and finish they were equal to the standard of good English makers.

UNIVERSAL FORGING MACHINE

B. & S. MASSEY, LTD., MANCHESTER, ENGINEERS

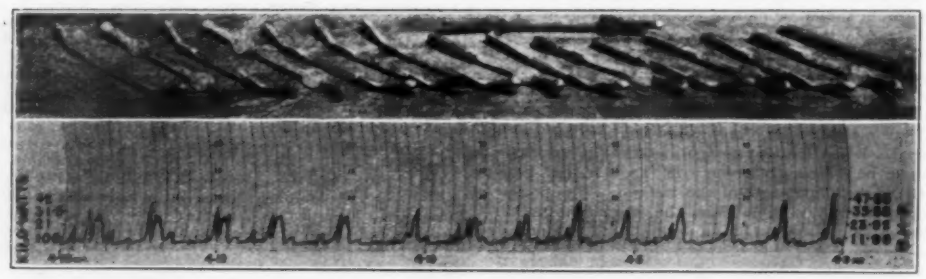
Forging Machine for Repetition Work.

Our attention has been called to an interesting application of a forging machine to the performance of repetition work. The actual machine referred to is the universal forging machine made by B. and S. Massey, Ltd., Manchester, and the articles produced are motor car axles "uses." The machine is driven by an electric motor mounted on the framing, making a very compact unit accessible from all sides It is capable of dealing with smiths' work of all kinds usually done under a steam or power hammer of 10 cwt. to 15 cwt. sizes. This forging machine has been on the market some little time and has already been described in The Engineer, but we may briefly recapitulate some of its principal features. The work is handled and produced as under the hammer, but the machine resembles a press in the quietness and smoothness with which it operates.

The main working part is a ram, bored to form a cylinder and containing a piston to which a constant up-and-down movement is given by a crank at the top of the machine. The extent of this movement is only 2¼in., but the number of strokes can be as many as 100 per minute. Reciprocating movement is transmitted to the ram through oil in the cylinder and by means of a valve, the height of the ram while reciprocating can be varied. Thus with the foot lever in its highest position the ram is 10in. from its anvil when at the bottom of its 2¼in. stroke. As the foot lever is depressed this space is decreased until the pallets meet. When the work is placed on the anvil the ram is brought down by means of the foot lever to give it one or more squeezes, the extent and number of which are under direct control, the ram returning to its highest position when the foot lever is released. For large or heavy work the machine is controlled by hand instead of by foot, but we are not concerned with this feature in the present article.

In our illustration the operator is shown roughing out motor car front axles preparatory to the stamping operation in dies. For the particular axle illustrated a 2in. square billet is employed and is cut off into lengths weighing 32 lb. as shown at A. The dies in the machine are arranged with four impressions for forging, swaging, forming the pad, and bending to shape. When one end of the billet has been dealt with as at B the other end is heated and forged, and at the same heat the "use" is drawn out to the desired length as at C. Two finished axle stampings are shown at D.

In order to demonstrate the expedition with which this work is carried out a test was made over a period of nineteen minutes, during which seven complete axle uses were made. The illustration below shows the ammeter diagram for the period, and above each peak in the curve the actual forging dealt with is shown. It should be explained that the seven "uses" on the left hand are, of course, the same pieces as the seven on the right after being drawn down at both ends. A unit meter in circuit showed that the total current consumption for the nineteen minutes was 3·5 kWh *i.e.*, half a unit per axle; allowing for 85 per cent. electrical efficiency, an average of 12¼ brake horse-power or, it is claimed, about a third of the power that would be required to perform the same work by a pneumatic power hammer is needed.



Ammeter Diagram for Axle Forgings

Besides being very efficient another advantage which this process possesses is that the cheaper rough rolled billet can be used instead of the finished bars of smaller section which are needed for an upsetting process.

Losses of Efficiency in Steamship Performance.

A paper read by Mr. J. Denholm Young before the North-East Coast Institution of Engineers and Shipbuilders on Thursday, November 15th, dealt with the various mechanical losses which may affect the efficiency of steamship performance. It was divided into two parts, the first relating to losses associated with hull and deck, and the second losses connected with the design and operation of the propellling machinery and engine-room auxiliaries

Dealing with the relative times spent at sea and in port, the author gave particulars of the performance of six typical tramp steamers taken over a year, calling at sixteen ports per annum, and showed that about 43 per cent. of their time was spent in port and 57 per cent. at sea. Further examples of the time spent in port, by different classes of ships, including loading and discharging, bunkering and voyage repairs, indicated that the percentage of the year in port might vary from 58 per cent. to 60 per cent. for a timber trader, 50 per cent. to 55 per cent. for a tramp steamer, 30 per cent. to 40 per cent. for a cargo liner, and 15 per cent. to 20 per cent. for a motor tanker.

With regard to the total time lost under repairs, the author suggested that it was probable that the ordinary 10-knot cargo steamer was the type with the least loss, and motor cargo vessels were about the same. With high-powered fast-running ships a specific period for annual overhaul would appear to be necessary. Referring to deck machinery, Mr. Young showed that waste might be reduced by using electric winches and steering gears, and that in steam installations there was a definite saving of 25 per cent. in the fuel required to keep steam, by superheating the 120 lb. deck steam to the extent of 50 deg. Fah. in uptake superheaters.

Losses due to weather, foul bottoms and variation in course were also referred to, and minor factors, such as the appendages, the form and application of the rudder and other details, were mentioned. The section of the paper which dealt with the main and auxiliary machinery was illustrated by diagrams and tables. For the ships of the type dealt with by the author, namely, cargo ships of about 420ft. in length, with 12,500 to 13,000 tons displacement, propelled by reciprocating steam engines of about 2200 I.H.P. and having auxiliaries of about 300 I.H.P., he holds that the following conclusions are justified:—

(1) The boiler efficiency can be increased from the old standard of 60 to 65 per cent. to 75 and 80 per cent. or more by the use of artificial draught, combined with the regenerative heating of the air before combustion, and still higher by mechanical stoking.

(2) The main engine frictional and mechanical losses have been reduced in modern practice to about one-half of the old amount or less than half, namely, from 15 per cent. to 7½ per cent., and in some cases 5 per cent. for reciprocating engines.

(3) The internal heat losses of the engine by condensation may, apart from steam jacketing, be reduced by an amount varying with the degree of superheat, the efficiency increasing up to a point still to be reached; but of this reduction in loss the greatest share per degree rests with the lower degrees of superheat.

(4) The exhaust losses may be reduced by regenerative feed heating, also by exhaust turbines and by fitting apparatus for the intensive extraction of air from the condensers.

(5) The saving of heat losses due to engine-room auxiliaries is very much within the control of the designer, provided that he is free to adopt modern methods in place of ordinary steam auxiliaries.

The history of engine development would seem to show that the principal barriers to economy and efficiency originated both in theory and in practice, and had to be attacked from both standpoints.

American Engineering Standards Committee. — On November 1st the American Engineering Standards Committee passed out of existence and gave way to the American Standards Association. To the layman, the basic difference between the old organisation and the new appears to lie in one qualification contained in five words in the new constitution of the American Standards Association. This qualification is "but not to formulate standards." The new organisation exists merely to provide systematic means by which units in industry, when they find it necessary to set up standards, may come together for the purpose of formulating them. The American Standards Association is to take no initiative, but is merely to serve by providing the place, as it were, where industrial units may get together and decide on what standards they themselves want. To give the standards which industry itself so decides upon an "official" label, the new organisation will contain a Standards Council. This Council will be the custodian of the rubber stamp to stamp standards which are agreed upon by industry. As soon as an industry finds that a standard has outlived its usefulness, the document which contains it can be returned to have the rubber stamp endorsement cancelled.

The Faraday Society: Twenty-fifth Anniversary Meeting.—To commemorate the twenty-fifth anniversary of the founding of the Faraday Society, a luncheon was held at Jules Restaurant, Jermyn-street, London, on Friday, November 9th, followed by the delivery by Sir Oliver Lodge—at the Royal Institution—of the first Spiers Memorial Lecture, the subject being "Some Debatable Problems in Physics." This lecture was given in accordance with the terms of a trust founded to keep alive the memory of the late Mr. F. S. Spiers, a founder of the Society and its Secretary and Editor throughout the period of its history until his death on May 21st, 1926. Professor T. M. Lowry, F.R.S., President of the Society, was in the chair at the luncheon, which was attended by representatives of scientific societies from many parts of the world. Prof. E. C. S. Biilmann, proposing the toast of "The Faraday Society," spoke highly of the work it had done during its twenty-five years' existence, and said that scientists abroad wished it all possible further success. He particularly stressed the value of the general discussions which had been a feature of the work of the Society, and, speaking of the work of Oersted—his countryman—on the one hand, and Michael Faraday on the other, handed to the President of the Faraday Society a copy of two volumes of correspondence between Oersted and the scientific societies and also with Faraday. Mr. James Swinburne responded to the toast in a characteristically humorous speech, and added that a great deal of the success of the Society had been due to the late Mr. Spiers, who had shown a special aptitude for organising discussions. He contrasted the average discussion before a technical society with the very comprehensive discussions which the Faraday Society held, the latter being discussions by experts in the particular subject, whereas it was too often the case in an ordinary discussion that speakers would say they had not had time to read the paper and frequently were not able to add any information of value. The President, acknowledging the toast, said that as long ago as 1923, when he had the pleasure of inviting the Faraday Society to Cambridge, the fiftieth general discussion was celebrated, but the success of those general discussions was largely due to the willingness with which distinguished scientists in other countries came here and took part in them. He expressed the hope that the international spirit would be fostered and developed and that there would be before long international general discussions, although they could not be very different from those that had been held by the Faraday Society in the past owing to the assistance of scientists in other countries. There could, however, be international general discussions in the various countries. Professor F. G. Donnan proposed "The Guests" and Professor K. Fajans and Senator Marconi replied.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Awaiting Developments.

CHIEF interest this week has centred in what is happening on the Ruhr. Up to now there have been no direct effects in the Midland market, but when one recollects that the approximate productive capacity of the works which are idle as a result of the lock-out in Germany is estimated to be about a quarter of a million tons of steel per week, the displacement involved must, if the dispute is not soon ended, be felt very widely. It is hoped that the trouble abroad will result in a bigger output from home mills, and there can be no doubt that steelmasters in this area are making every effort to induce manufacturers, who customarily utilise foreign steel, to place their orders at home. Buyers are hesitating at the moment, and business on the Birmingham Exchange is slow. That consumers will come forward with their business as continental supplies become more restricted is the prevailing impression. Meanwhile, steelmasters are maintaining their prices at recent levels, hoping thereby to encourage sales. There have been no new developments during the week in either raw or finished iron.

Steel.

The German industrial conflict has had no appreciable effect upon the Midland steel market up to the present. Native makers are perhaps increasing their order books, but they do not consider it advisable to push up prices. The recent stiffening of values, as supplies of continental materials have become scarcer and prices higher, has carried billet prices to £6 7s. 6d. and small bars to £7 15s. minimum. Steelmasters appear to be exerting their efforts more with the object of persuading consumers of continental materials to forsake them for native supplies than with the idea of profiting by means of higher prices, by the trouble in Germany. Many Black Country re-rollers have good stocks of foreign material, either at the works or in the course of transit, but endeavours to relieve re-rollers of their dependence on continental semis are being made. This week Belgian and French shippers have withdrawn quotations pending developments, but there is no tension in any direction. The latest quotations procurable were £6 for billets, £7 5s. for steel bars and £7 2s. 6d. for iron bars, all delivered. British strip mills have established such an ascendency in the market of late that a refusal of continental makers to sell under £7 Antwerp—upwards of £8 delivered here—has had no tangible effect. In the finished steel department business is on the quiet side. Constructional engineers complain of the severity of competition for the available work. Native steel prices remain unchanged. Recently, continental steel houses have been offering building steel through agents in London to Birmingham structural engineers. Joists of 28 to 32 tons tensile can be had at £6 9s. 6d. per ton f.o.b., with delivery in December or January. Another firm offers in a similar period angles at £5 18s. 9d. and tees at £6 10s. It would cost another £1 2s. 6d. to bring this steel from the ports, and very little finds its way to this district.

Pig Iron.

Demand for pig iron shows no expansion. Small parcels continue to be bought with marked regularity, but the amount of buying for forward delivery is almost non-existent. It is considered that the present demand is just about sufficient to absorb the current limited output. The stoppage of a Nottinghamshire blast-furnace will mean a reduction of something like 500 tons in the weekly output of foundry pig. Blast-furnacemen are displaying considerable anxiety as to the future, and rumours are current of further damping down of furnaces unless things improve. Inquiries amongst ironfounders do not encourage hopes of increased consumptive requirements. Makers of light castings in particular are poorly situated for orders. Midland smelters continue their efforts to secure business from the North, and meet with some success. Prices are nominally unchanged, but it is reported that concessions would be obtained for attractive orders. For Derbyshire No. 3 foundry £3 is the general quotation, and £3 1s. is occasionally mentioned, while Northamptonshire iron varies from £2 17s. to £2 17s. 6d. at furnaces. West Coast hematite is quoted between £4 5s. and £4 6s., and East Coast £4 4s. to £4 5s. A few sales of Welsh hematite have been made to Midland consumers. Forge material is practically inactive, and though quotations are unchanged they can hardly represent to-day's values. It would, indeed, be difficult to determine the figure which would represent the selling price of either Derbyshire or Northamptonshire forge material.

Finished Iron.

The position in the Staffordsnire finished iron trade is practically unchanged from what it was a month ago. Orders for best grade bars continue to come in from week to week, and mills are kept running regularly. There being no competition in this branch of the trade, the quotation for marked bars remains at £12 pending any agreed change by ironmasters. Competition in the Crown bar department is unabated, and values range from £9 2s. 6d. to £10. No great volume of business is being offered for this class of material, and it cannot be said that Staffordshire mills are getting even their fair share of what is available. Plant consequently is irregularly employed. The demand for Staffordshire common bars for nut and bolt and hurdle making is poor. Belgian No. 3 iron, which answers a similar purpose, is procurable at £7 5s., while native iron is £8 12s. 6d. minimum, with many ironmasters demanding £8 17s. 6d. The Darlaston nut and bolt works are not so busy as they were, and call for less raw material. The tube works also find business less brisk, and makers of wrought iron gas tube strip do not find it easy to dispose of their production at £10 15s. Some sellers stand out for £10 17s. 6d., but the former figure is most generally accepted.

Sheet Prices Easier.

Values of galvanised sheets have declined to the extent of half-a-crown per ton. Makers of corrugated sheets are working off old orders faster than they are replacing them, and though most of them are booked well ahead, they display some keenness in securing new business. This has caused buyers to quibble over prices, and, as a result, some houses which quoted £13 12s. 6d. for 24 gauge sheets a few weeks ago are now selling at £13 10s., while mills which recently asked £13 15s. have conceded a similar amount, if not more. Last month's output from the mills is reported to have been very good, and efforts are being made to keep up the production to this level during November.

Trade Returns.

Iron and steelmasters and manufacturers in this area have this week given careful study to the trade returns for October. They discover with regret that when compared with the corresponding period of 1927 the value of the month's exports of iron and steel was £11,272 lower at £6,023,291, the total quantity being 377,390 tons, against 384,784 tons in October last year. Taking the trading returns as a whole, however, there was a welcome increase in exports during the month. Of the advance made on October, 1927, in exports, articles wholly or mainly manufactured accounted for £2,064,947, or just about two-thirds. The principal increases were vehicles, including locomotives, ships, and aircraft, £1,121,221; cotton yarns and manufactures, £445,326; chemicals, drugs, dyes, and colours, £261,107. With regard to imports, comparing last month with October, 1927, there was a reduction, due mainly to a falling off in raw materials and articles mainly unmanufactured. Imports of iron and steel in the manufactured group were lower by £370,432. There was an increase of £788,350 in imported non-ferrous metals and manufactures. The unsatisfactory feature of the imports was that while raw materials fell by £4,225,969, the total for articles wholly or mainly manufactured rose by £1,513,275. The total quantity of iron and steel imported during the month was 261,404 tons, compared with 336,020 tons in the corresponding month of last year. For the year to date the quantity imported was 2,479,492 tons, compared with 3,840,841 tons in the preceding year.

Birmingham to U.S.A.

Exports from the Birmingham district to the United States last quarter showed an increase of 7 per cent. when compared with the corresponding quarter of 1927. The largest individual item was steel tubing, of which shipments to a value of 238,227 dollars were dispatched. This item was not specified in previous returns, steel tubing having been included with various exports under the head of "Other metal manufactures." In a reclassification introduced by Consul Campbell, particulars will appear henceforth of several descriptions of goods about which exporters and importers alike will be glad to have precise information. These include plated ware and silver, iron and steel products, the last quarter's exports of which were 21,285 dollars; tinned sheets, 18,662 dollars; fish hooks and tackle, 9279 dollars. It is of interest to note that Midland glass manufacturers have found a steadily improving market for their wares in the United States. Last quarter exports amounted to 153,565 dollars. The comparative figure in the previous quarter was 119,538 dollars, and in the corresponding period last year 74,875 dollars. Steel window sashes, 59,004 dollars, showed a slight improvement on the second quarter, but a sharp decline on the corresponding quarter last year. Brassware shipments totalled no more than 60,724 dollars, against 72,636 dollars in 1927.

Canal Bridges.

Midland, and in particular Birmingham and South Staffordshire, manufacturers are somewhat alarmed at a report that the question of canal bridges is likely to be left out of the Roads and Bridges Bill which it is hoped will be passed through Parliament during the present session. The matter of weak canal bridges has created a grave position in this area, where the canal owners have issued warnings against the use of many bridges which are insufficiently strong to carry modern heavy motor transport. A large number of manufacturers, were they to recognise the notices posted, would be unable to get their raw material into the works or their finished goods out. During the past two years the seriousness of the problem has been brought home to the various chambers of commerce, trades and motor users' associations, local authorities and other interested parties. The Ministry of Transport has been waited upon without much satisfaction being gained and the Midland Association of Local Authorities which has the question in hand has intimated that effective action is not contemplated by it in the absence of legislation. Legislation has been contemplated for years past, but it now appears it is to be relegated to a future remote period, so far as canal bridges are concerned. In deference to influential representations from various quarters, the Birmingham Canal Navigations have not so far taken drastic action to safeguard their bridge structures in anticipation that the question would be provided for comprehensively by an early Act. In several instances, serious damage has already been caused to bridges by heavy traffic, and the canal company cannot be expected to shoulder indefinitely the risk of further damage in the absence of either a proper understanding with the various local authorities affected or an Act enabling it to initiate schemes of improvement. Mr. P. Nadin, manager of the Birmingham Canal Navigations, suggests that, before it is too late, the whole position ought to be reviewed, and if there are points to be cleared up between the parties principally concerned, viz., the County Councils' Association, the canal companies, and the Ministry of Transport, then they should be settled at once.

Unemployment.

Following a substantial increase last week, due to short time in some of the colliery areas, the latest return showing the number unemployed in the Midlands gives a decrease of 9958. The total now stands at 177,499, of whom 134,916 are men, 35,426 women, 3872 boys and 3285 girls. The totals for the principal towns are Birmingham area, 28,036; Bilston, 2274; Coventry, 3959; Cradley Heath, 3715; Derby, 4470; Dudley, 2964; Leamington and Warwick, 728; Leicester, 6959; Northampton, 4000; Nottingham, 8203; Oldbury, 944; Peterborough, 521; Redditch, 1470; Smethwick, 2737; Stoke-on-Trent area, 18,224; Stourbridge and Brierley Hill, 2023; Tipton, 1709; Walsall, 5119; Wednesbury, 2002; West Bromwich, 2414; Wolverhampton, 5508; Worcester, 1374.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Exports of Textile Machinery.

THE shipments of British textile machinery last month indicate a substantial recovery from the low returns relating to September, even allowing for the fact that October had one more working day. It is still the case, however, that the month's exports were below the level of the corresponding period of last year. The October shipments of 10,317 tons valued at £943,988, compare with 10,549 tons and £1,040,992 a year ago, and include 7667 tons of spinning and twisting machinery, valued at £710,564, and 2135 tons of weaving plant, valued at £156,055. The fluctuations in the trade in textile machinery are reflected in the changes that have occurred in the markets. Compared with September, exports to British India, the Netherlands, France, China, Japan, South America, Australia, and "other European countries" show improvements of varying extent. A substantial decline has taken place in shipments to Russia, and less important declines have occurred in the case of Germany and the United States. Exports to British India reached a total value during the month of £255,402, followed by Japan with £98,078; France, £66,786; Germany, £65,676; South America, £60,213; the Netherlands, £51,603; Russia, £43,045; China, £33,559; the United States, £26,219; and Australia, £17,097; "other European countries" accounting for shipments which reached an aggregate value of £187,651.

Steel Company's Heavy Losses.

Serious losses during the past year are disclosed in a report which has just been issued by the directors of the Partington Steel and Iron Company, Ltd., a subsidiary company of the Pearson and Knowles Coal and Iron Company, Ltd., both of which concerns have received the sanction of the High Court to schemes of arrangement. In the case of the Partington Company the balance-sheet for the year ended June 30th last discloses a loss of £149,861, bringing the balance at debit of profit and loss account to £524,999. Under the scheme of arrangement, the principal changes in the balance-sheet are that freehold and leasehold land, buildings, plant and machinery now stand at £1,751,801, compared with £3,366,591 in the old balance-sheet, and investments in and advances to other companies at £12,946, against £142,212. The present capital of the company under the scheme amounts to £936,274, compared with £1,600,000 previously, the former figure including new capital raised under the scheme. Similar drastic changes have been made in various items standing in the balance-sheet of the Pearson and Knowles Company, and the issued capital now amounts to £378,758, compared with £1,608,500 formerly.

The New Partington Gasworks.

Although still far from complete steady progress is being made with the construction and equipment of the Manchester Corporation's new gasworks situated at Partington. The plant is designed for a total output of 40,000,000 cubic feet of gas daily. The complete installation will consist of five units, each comprising Glover-West vertical retorts and Drake horizontal retorts capable of producing 8,000,000 cubic feet a day between them. Distribution of the gas to the city will be by means of a 13-mile long steel main, 36in. in diameter.

Tramways Manager and Engineer.

It is stated that about twenty applications have been received for the position of general manager and engineer of the Manchester Corporation Tramways, which was rendered vacant by the recent death of Mr. Henry Mattinson. The applications are to be considered by a sub-committee, which will meet shortly for the purpose of making recommendations to the Tramways Committee. The position carries with it a commencing salary of £2000 a year.

Non-ferrous Metals.

The principal feature of the operations in the non-ferrous metals market during the past week has been the continued firm tone of the tin section, although the highest point touched during the week has not been maintained. On the whole, the demand for the metal has been of fair extent, and on the strength of this the high values reported here a week ago were not only held, but a further advance of about 20s. a ton was registered at one time. This was the point at which the market closed last week end. Since then there has been a slight reaction, and on balance prices are a few shillings a ton below what they were at last report. In view of the fact that increased supplies are expected to come on to the market before long, spells of easiness are not improbable. Buying interest in copper has been rather less pronounced than of late, but the firm undertone is reflected in the slight improvement in values of standard metal that has taken place, although these are still fractionally below the high levels of a fortnight ago. With regard to refined descriptions, there have been further advances varying from about 5s. to 10s. per ton. The fact that offers of spelter are not excessive at the moment has resulted in renewed steadiness, and quotations are somewhat dearer on balance.

The demand for lead is not particularly active, and this, coupled with the fact that largely increased supplies are available, has exerted a further depressing influence on prices, the loss on the week being from 5s. to 10s. a ton.

Iron.

Rather mixed conditions still obtain in the pig iron market locally. New transactions of any weight are less numerous than they have been, and most makers selling here seem to be rather disappointed with the extent of the autumn buying campaign. On the whole, however, a good tonnage has been bought during the past two months or so. What is a matter of greater immediate concern to some producers is the fact that delivery instructions against contracts are not being received quite so briskly as could be desired. This, of course, is due primarily to the fact that a good many consumers are themselves not too happily placed from the point of view of work in hand. In spite of this, however, pig iron makers generally are holding on to recent prices, and, for the time being at all events, the tone of the market appears to be against any concessions. For delivery Manchester or equal, Derbyshire brands are being quoted on the basis of 68s. per ton, and Staffordshire iron at 67s. 6d. Scottish No. 3 varies from 87s. 6d. to 90s., with Middlesbrough at 79s., and hematite at about 82s. per ton, all delivered. Lancashire Crown bars are quoted this week at £10, and seconds at £9 10s., but there has been little improvement in the demand in this section of the market.

Steel.

Although one or two new constructional engineering contracts have been placed in this area the outlook in this branch generally is not too cheerful at the moment, and unless prospects improve before long a decline in the movement of steel on this market may be expected. A good demand continues to be reported for special quality bars for bright drawing, with, perhaps, less activity than of late in ordinary small re-rolled bars. The demand for boiler plates just now, both from locomotive builders and from the boiler-making industry, is on the quiet side. The needs of the former, who are fairly actively engaged, are understood to have been covered for the time being. There has been very little alteration in prices, and the position generally in this respect is believed to be firm. Small bars are being quoted by re-rollers at from £7 17s. 6d. to £8 per ton, according to quantity, with large bars at £8 17s. 6d., joists and sections at £7 17s. 6d., ship and tank plates at £8 12s. 6d., and boiler plates at £9 10s. for basic and £9 15s. for acid sorts. Here and there continental steel prices are nominally firmer, but available supplies are limited, and neither buyers nor sellers in this section seem to be at all anxious to commit themselves.

BARROW-IN-FURNESS.

Hematite.

There is very little change in the general tone of the pig iron market at the present time, but it is not wise to view the future with too much confidence. There is inclined to be an unsettled feeling about it which does not exactly assure one as to the future. It may be that trade will continue in its present volume for some time, but, on the other hand, it might begin to fall off. There is really not much to go by at the moment, but it is possible that the demand for iron might be affected by the possible quietness in the steel trade. If the steel departments concerned with railway material begin to have slack periods it is possible that the production of iron will exceed the requirements, and that will mean some going into stock or finding buyers further afield at prices which, to say the least, will not be very remunerative. There is very little change in the iron ore market, and, generally speaking, the activities at the various local mines are more or less restricted. The same remark applies to the imports of foreign ore. The steel trade is not very bright. Orders are difficult to secure, and prices are being cut to secure contracts. Locally the condition is not very good, and it is necessary for further contracts to be secured if the running of the rail mills is to be assured. In the hoop department, however, there is no lack of business.

Shipbuilding.

Towards the end of this month there will be launched from the Naval Construction Works of Vickers-Armstrongs the naval tender "Resource," which outwardly will be similar to the "Medway," which is now being fitted out in the docks. The "Resource" will be driven by twin sets of M.A.N. internal-combustion engines, built under agreement with the German company by Vickers-Armstrongs at Barrow.

SHEFFIELD.

(From our own Correspondent.)

The Heavy Branches.

ALTHOUGH one hears of an improvement here and there in the heavy iron and steel trades, it cannot be said that there are yet any signs of that definite revival for which everyone is anxiously waiting. The producers of the cheaper qualities of basic steel are fairly busy, and are maintaining the recently improved output. This class of steel is benefiting from the decline in continental competition, but it is rather curious that, during the past week, orders for local firms have fallen off. This has not made any difference to the working arrangements, as the plants are operating on orders in hand, but it is essential that considerably more work should be placed in the near future if the present reasonably busy conditions are to continue. Orders for the better qualities of basic steel or for acid steel are not coming through any too well. It is reported that the makers of the soft qualities of crude steels are inclined to ask for an additional 2s. 6d. per ton. There is no desire to help continental makers to regain the position they held some months ago, for local manufacturers are determined to maintain the present favourable competitive position; but at the same time they are working with the narrowest of profit margins, and it is felt that this increase of 2s. 6d. would make a tremendous difference to them on the profit side of the balance sheet. The iron market also shows a slight upward tendency. The light ironfoundries are experiencing a slight wave of depression, which unfortunately gives signs of developing; but to set against that is the fact that a number of engineering shops in the North of England and in Lancashire are placing larger orders for their raw material.

Railway Steel Depression.

Sheffield and Rotherham firms are suffering very severely from the absence of orders from the railway companies, and many plants have been standing in complete idleness for a considerable time. In these circumstances, it is not surprising that local manufacturers have drawn attention to the policy of the railway companies in this country in undertaking the manufacture of rolling stock, rails, springs and other articles they require. In a recent issue of the *Journal* of the Sheffield Chamber of Commerce it was suggested that, by their policy, the home railways are hindering trade revival. A prominent Sheffield steel manufacturer states in an interview that that has been a sore point with manufacturers of railway material for many years, and he continues: "The question has assumed perhaps even a greater importance at the present time, in view of the depression in the steel trade and its auxiliary trades, and the difficulties in which the railway companies find themselves, owing to loss of freight. Having regard to the growth of road competition, there is no doubt that the railway companies will have to look more and more to the heavy industries for the provision of freight. Therefore, it would seem only reasonable to expect that they should do everything in their power to foster those industries. The railway companies would be acting in their own interests if, instead of setting themselves up as competitors, they tried to assist the manufacturers of railway material in every possible way. It seems very unfortunate that the London, Midland and Scottish Railway should have recently spent a very large sum of money in modernising its steel-making plant, while the steel works of the country are working only to something like 50 or 60 per cent. of their capacity. If the railway companies changed their policy, any displaced labour could, I am confident, be readily absorbed by the private manufacturer, for a stimulus would be given to production."

The Tool Trades.

Business in tool steel and tools is fairly satisfactory, but the quantity of material going for shipment is not as large as one would like. Several important markets are buying badly at the moment, and competition abroad seems to be getting keener than ever in some directions. Mr. R. A. Bedford, a director of John Bedford and Sons, Ltd., crucible steel manufacturers, Sheffield, recently visited Spain to initiate an agitation against the proposed prohibitive duty on steel and files, and following that visit the Council of National Economy, subject to the approval of the Spanish Government, has drawn up a scale of duties which is considerably lower than that originally proposed. For example, the old duty in the case of files was 67·2 pesetas per 100 kilos. The suggested duty, which brought forth the protest from Sheffield, was 250 pesetas, and the duty now recommended by the National Economy Council is 92·4 pesetas. The reductions are on a similar scale as regards alloy steel and high-speed steel. There is a remarkable change in the case of stainless steel. The old duty on that material was 165 pesetas per 100 kilos. The first proposed duty was 348 pesetas, and the rate now recommended records a big drop to 84 pesetas. Another case in which there is actually a reduction on the old duty is that of steel with alloys up to 5 per cent. The old duty was 165 pesetas, the proposed duty was 348 pesetas, but the latest recommendation is 99·6 pesetas. In the case of both files and steel the figures include the extra percentage charged for the difference between the present exchange and the gold exchange. The Spanish agents of John Bedford and Sons, Ltd., write: "We have gained an overwhelming victory, and I congratulate Mr. Reginald A. Bedford on his wise generalship. Thanks to his visit to Spain, we can remain tranquil now for five years with regard to files."

Plate and Cutlery.

The plate and cutlery trades are now getting well into their busy season, and plenty of activity is noticeable, in spite of the fact that some firms express disappointment at the way in which the seasonal trade is developing. A feature this year has been the great demand for cheap table cutlery and small plated articles. The output of them is on an enormous scale, and to a certain extent that may have hampered the sales of better quality goods. At any rate, it is reported that there is some slackness in the production of silver and good-quality electro-plate and cutlery. Several large contracts have been placed by shipping companies, hotels, and restaurants for good-quality articles.

Sheffield Contracts.

The erection of a plant for the Bussey Coal Distillation Company, Ltd., at Glenboig, has a considerable interest for Sheffield. The laying of the concrete foundations for the retorts, apparatus and buildings, has been entrusted to G. P. Wincott, Ltd., of Sheffield, and Dewhurst's Engineering Company, also of Sheffield, is making rapid progress at its shops in the fabrication of retorts and much of the auxiliary apparatus. One-half of the retort casings is now ready for shipment.

Colliery Improvements Completed.

The Maltby Main Colliery, which was temporarily closed in August last to enable certain structural alterations to be carried out, is about to resume coal drawing. During the period this pit has been standing, extensive additions have been made to the screens and washer plant, with the result that the surface equipment of the colliery will now be capable of dealing with a weekly output of 25,000 tons. This statement has been officially issued by the Maltby Main Colliery Company, Ltd., and Mr. H. C. Harrison, the general manager, said that, though it would not be possible to restart the whole of the 2000 men who were thrown out of employment, they would be gradually absorbed, and it is hoped that in a few weeks the majority would be working.

NORTH OF ENGLAND.

(From our own Correspondent.)

Business Improving.

ALTHOUGH the volume of business in the North of England iron and steel trade still leaves much to be desired, there are, nevertheless, unmistakable signs of improvement. The most encouraging section is that of manufactured steel, large outputs being maintained, and many of the firms having good order books. Confirmation of the view that the trade tide has turned is afforded by the fact that at least one firm has had to introduce Sunday shifts at its rolling mills in order to cope with the increasing business. Iron and steel producers are certainly in a better position to compete in the world markets than they have been for several years past. Continental prices have risen sharply in recent weeks, and, not only has the flood of imported material into this country been checked, but considerable progress has been made in the recovery of overseas trade. So far the suspension of operations at works in Germany has had less effect on trade in this area than might have been expected. While news to hand indicates a grave situation in Germany, the prevailing opinion among producers in this district is still that the lock-out will not be of long duration. A business letter received from Germany by a Tees-side firm of merchants is of interest. It intimates that at some of the works a large percentage of the men was against the action of the unions in claiming an advance in wages. All parties realise the disastrous nature of the conflict, and important developments may occur at any time. The letter adds that the trouble is not confined to the iron and steel industries, but concerns textile and other trades, and fresh labour conflicts are threatened.

Cleveland Iron Trade.

Inquiries in the Cleveland iron trade are expanding, and actual sales are better, but as yet conditions on the Continent have not created excessive buying. The decrease in Cleveland iron stocks last week was unusually heavy, running into several thousand tons. Much of the iron was for inland destination, but a certain amount was sold for export. These heavy deliveries were due chiefly to accumulations and to some expansion of demand—a tendency still discernible. Stocks of Cleveland iron are very low, and local works continue to absorb the bulk of the current output. Fixed prices that have ruled for some months past are firmly upheld, No. 1 being 68s. 6d.; No. 3 G.M.B., 66s.; No. 4 foundry, 65s.; and No. 4 forge, 64s. 6d.

Hematite Pig Iron.

There is a marked scarcity of East Coast hematite pig iron, and the re-kindling of an idle furnace at the Normanby Works of Pease and Partners, Ltd., is a welcome event. Stocks are about exhausted, and the restricted output is absorbed by the current moderate demand. Steady business is passing with both home and continental consumers. Terms on which contracts are arranged are a matter of individual bargaining, and consequently quotations vary somewhat, but the tendency is markedly upward. Producers, however, are still accepting orders at unremunerative figures. There are buyers on the basis of 70s. for ordinary qualities, and contracts for deliveries early next year have been made at the equivalent of a higher figure.

Ironmaking Materials.

Business in the foreign ore trade continues very quiet, but imports under running contracts are still on a heavy scale. Arrears are gradually being overtaken. Best Rubio ore remains at 22s. 6d. c.i.f. Tees. Sellers of Durham blast-furnace coke put the quotation for good medium qualities at 17s. 6d. delivered to works in this district, but consumers are not inclined to negotiate for supplies at that price.

Manufactured Iron and Steel.

Activity at the manufactured iron and steel works is increasing, and the outlook is regarded as very encouraging. Finished iron producers are busy, and the aggregate output of steel is heavy. In one or two branches, however, producers would welcome more orders. Further expansion of demand for semi-finished steel is noticeable. Quotations are steady and unchanged.

The Coal Trade.

The signs of improving demand in the North of England coal trade are undiminished, and the outlook is brighter than for a long time past. In both counties—Northumberland and Durham—the steam and gas coke collieries are working more regularly than at any previous time this year. Production is not, of course, anything like what it used to be, but the demand has at length drawn level with the output. Orders on hand for the next two months total substantial figures, and there are still considerable quantities under negotiation. The tonnage difficulties and delays at the loading staiths are proving a big handicap to producers. There are collieries in the irritating position of having full stem sheets and yet are compelled to look for trade because they have coal on hand which ought to be shipped. Many of the collieries in Northumberland are well sold for this year, both in regard to best steams and second qualities, and prices are fully maintained. Best steams are quoted at 14s. to 14s. 3d., and seconds at 12s. 9d. to 13s. Steam smalls are not as active as large coal, and much more trade could be dealt with. Durham steams, whilst amply sold, are moving slowly through continued lack of tonnage supplies. Fitters, however, adopt a firm attitude, best qualities being at 15s. 9d. and smalls 11s., and concessions are only

obtainable where definite tonnage can be stemmed to suit the available positions. There is more business passing in gas fuel, and prices are firmer at 14s. 9d. for best qualities and 13s. 3d. to 13s. 6d. for seconds. All coking coals and smalls are in ample supply, but unchanged in price. There is a quiet movement in gas coke, and discounts are becoming easily obtainable, as many contractors are offering on the market in consequence of stocks being thrown on their hands through failure of shipping facilities. Sellers quote easily at 19s. 6d. Patent cokes on the whole are steady, but buyers can readily cover at 18s. 3d. to 18s. 9d. for good ordinary brands. Beehive and special grade cokes are steady at 23s. to 28s.

Order for Locomotives.

Sir W. G. Armstrong, Whitworth and Co. have secured an order for ten locomotives and tenders for the Great Western of Brazil Railway Company, Ltd. These locomotives will be manufactured at their Scotswood Works, and are to be shipped to Pernambuco in one of the locomotive and carriage-carrying vessels constructed by the firm especially for this class of work. It is also announced that the firm has effected the sale of a steam cargo vessel of 6540 tons deadweight to the Stag Line, Ltd., of North Shields.

Order for Whalers.

Smith's Dock Company, Ltd., South Bank, Middlesbrough, has secured an order for seven whalers, each 175ft. long, from a Norwegian firm. The order will help materially to keep the firm's Tees establishment in employment over the turn of the year.

SCOTLAND.

(From our own Correspondent.)

Steel and Iron.

The situation abroad caused by the developments in Germany provides the chief item of interest in steel and iron circles. General opinion favours an early settlement of the German lock-out, but the possibilities of the situation in respect to the home trade, should the trouble be prolonged, are not lost sight of. Meanwhile, no direct benefit has accrued, apart from an increased demand for re-rolled steel bars. Consumers of these bars have shown anxiety to anticipate their requirements, and the call for immediate deliveries has been so brisk that makers have increased their prices to £7 15s. per ton, home or export. Makers of heavy steel report some improvement in orders for shipbuilding material and a slightly better export demand. Steel sheet makers are well supplied with orders for light gauges and galvanised descriptions, but the heavy varieties still lag behind. Tube makers are busy. Bar iron is dull, and pig iron continues comparatively inactive. Prices on the whole are unchanged.

Shipbuilding Orders.

Orders have been placed by H. Hogarth and Sons, Glasgow, for six cargo steamers of 6080 tons deadweight with Clyde shipbuilders. Since the war, Messrs. Hogarth have placed orders on the Clyde for twenty-nine vessels, ranging in size from 5300 tons deadweight to 10,250 tons.

Imports and Exports.

During the past week 7000 tons of iron ore and 3000 tons of steel and iron materials were discharged at Glasgow Harbour. Within the same period, steel and iron materials to the amount of 7800 tons were dispatched abroad, also 250 tons of pig iron.

Coal.

While the shipping market has been firm throughout the week, the position is not too satisfactory, as foreigners show reluctance to place orders at the prices current. Consequently, prompt and forward transactions are both restricted, and the business passing is largely made up of purchases against sales and the covering of the limited demands from abroad. Restricted outputs, however, maintain prices at a firm level. Home demands from industrial and municipal consumers expand as the year advances. Outputs of Lanarkshire ells are almost entirely disposed of for home consumption and this fuel is very firm at 16s. per ton. Splints are moving freely, and treble nuts have a ready sale. Fifeshire best steams are well sold, while third-class steams are practically unobtainable for some weeks ahead. Treble nuts in Fifeshire are especially firm. Lothians steams are dearer for all qualities. Double and single nuts and pearls have better demands than for some time back. Aggregate shipments amounted to 249,714 tons, compared with 219,218 tons in the preceding week and 246,917 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

Shipments of coal from this district last week were not good. They were, in fact, very disappointing, inasmuch as the total came to only just over 351,000 tons, which compares with over 458,000 tons in the previous week. This quantity is all the more surprising as tonnage to hand was rather better than usual, and at the end of the week there were only thirty idle tipping appliances at the various docks, whereas in previous weeks there have been over forty. Hopes are entertained that the figures for the current week will make better reading, as tonnage has come along better, and on Monday there were only thirteen tipping appliances idle. The prospects are also that the supplies will continue for a time to be more plentiful, as chartering of late has been on quite an active scale. The amount of tonnage which was taken up by merchants during the week ended the 9th inst. came to over 400,000 tons, this being the highest total recorded for any week of this year. This is distinctly good, though it must be admitted that operations in this line during this week have not been so brisk, and exporters having satisfied their requirements to a large extent, it is not surprising to find that outward rates of freight show a slight falling off. This is all to the good, as there is no doubt that the recent sharp advance in rates has had the effect of checking the inquiry from abroad. Considering all things, the demand is by no means unsatisfactory—that is, as regards supplies for delivery ahead—though the inquiry for supplies for quick shipment might be better. The Midi Railways of France are reported to have bought about 20,000 tons of Swansea patent fuel at a price which leaves about 19s. per ton, inclusive of wharfage, and the Danish State Railways have also bought through a local firm 18,000 tons of Welsh large coal for delivery over the next few months. News is awaited regarding the placing of the order for 40,000 tons of large coals for the Norte Railways of Spain, to be delivered over the next six weeks.

Future Coal Prices.

Some collieries have fixed up quite a fair amount of business over next year on the basis of the current minimum prices for coals, but there is no doubt that some buyers have been holding off operating in case the minimum price scheme should come to an end, enabling them to buy ahead at less than the present minimum values. There would appear, however, to be very little prospect of this happening, as from all accounts the deliberations taking place for tightening up the scheme, so that it shall involve the control in some measure of output are proceeding very satisfactorily, though it is not expected that details of the scheme will be completed for about another week or so. It is interesting also to note the statement of Mr. Finlay Gibson, the secretary of the South Wales Coal Marketing Association, that it is not the intention of the Association to make any decrease in the minimum prices in consequence of the reduction in railway rates which is to take place as from December 1st. During the three months ended July colliery losses amounted to over 1s. 8¾d. per ton, and there is no doubt that the audit for the three months ended October will also show a deficit. In these circumstances it will be the policy of the coal-owners to retain the whole of the small benefit, which it is estimated will average about 6½d. per ton on export coal, towards the mitigation of their losses. In any case, the minimum price scheme will not be affected at all by the coming into operation of the reduced railway rates.

Another 5000 Miners Idle.

Work at the Nixon Navigation Collieries at Mountain Ash ceased on Wednesday until further notice. As a result another 5000 workmen are idle. The pits have been working for some time on day-to-day contracts. It is reported that negotiations for the disposal of the undertaking have not terminated favourably.

The Cambrian Crash.

The South Wales coal trade has had many shocks in recent months and last week suffered another, when it became known that the shareholders of the constituent undertakings of the Consolidated Cambrian, Ltd., had received circulars advising them of an extraordinary general meeting to be held in London on Wednesday of this week for the purpose of considering a proposal for voluntary liquidation. The five concerns in the combine are the Cambrian Collieries, Ltd., Glamorgan Coal Company, Ltd., the Naval Colliery Company (1897), Ltd., Britannic Merthyr Coal Company, Ltd., and the Duffryn Aberdare Colliery Company, Ltd. The capital of the Consolidated Cambrian, Ltd., which is the holding company, amounts to nearly £1,800,000, but no dividend has been paid on the ordinary share capital since 1922, while the preference dividend share capital is 4½ years in arrear. The course of action which has been proposed by the directors has been dictated as the result of the heavy losses which have been sustained in recent years. The collieries in the combine employ altogether about 13,000 to 14,000 workmen, and a population of round about 40,000 people is dependent upon these collieries. The position is, of course, extremely sad, and every effort is being made to avert a total stoppage of work at the pits.

Siemens Steel Wages.

There was a meeting of the Joint Standing Committee of the Siemens Steel Trade Conciliation Board at Swansea on Saturday, and as a result it was reported that the 6¼ per cent. variation under the last ascertainment is to apply all round. The lower-paid men have an *ex-gratia* bonus which, with the sliding scale of 6¼ per cent., will give them 50 per cent. on their base scale. The effect of this decision is that certain sections of the men will benefit by an increase of 1¼ per cent. on their present rates of wages.

Current Business.

Although collieries are working a shade better, owing to the fact that tonnage being more plentiful there is a ready outlet for coals, the fact remains that the tone of the market continues to be dull. The demand for prompt supplies is not so heavy as yet to have a lifting influence upon values, though the opinion all round appears to be that the conditions are somewhat brighter, and that the outlook is slightly improved. Production, however, at the moment is in excess of requirements, especially as regards large coals. Patent fuel and coke remain unaltered, but pitwood is fairly firm, with prices round about 31s.

In the series of fogs that usually accompany the beginning of the winter months there only appears to have been one accident of note. It occurred on the Cheshire Lines at Trafford Park on Friday, the 9th. A morning business train from Urmston to Manchester Central ran into a goods train. Three passengers were hurt.

LAUNCHES AND TRIAL TRIPS.

Van Der Lijn, passenger and cargo steamer; built by Netherland Shipbuilding Company, Amsterdam, to the order of Koninklyke Paketvaart Maatschappy; dimensions, 290ft. by 43ft. by 21ft. 3in.; 2450 tons; launch, October 20th.

Creole Bueno, twin-screw oil tanker; built by Palmer's Shipbuilding and Iron Company, Ltd., to the order of Anglo-American Oil Company; launch, October 30th.

Creole Lindo, twin-screw steamer; built by Palmers' Shipbuilding and Iron Company, Ltd.; to the order of Sir J. W. Isherwood and Co., Ltd.; trial trip, October 31st.

Divis, turbine steamship; built by Workman, Clark (1928), Ltd., to the order of Belfast City Corporation; dimensions, 152ft. by 29ft. by 12ft. Engines, triple-expansion; trial trip, November 1st.

Highland Brigade, twin-screw motor vessel; built by Harland and Wolff, Ltd.; to the order of H. and W. Nelson, Ltd.; dimensions, 520ft. by 69ft. by 35ft. 9in.; to carry passengers and cargo. Engines, two eight-cylinder double-acting, four-cylinder motor engines, Harland-B. & W. type; constructed by the builders; launch, November 1st.

Behar, single-screw steamship; built by Harland and Wolff, Ltd., to the order of Hain Steamship Company, Ltd.; dimensions, 452ft. 6in. by 57ft. 4in. by 40ft. 9in. Engines, quadruple-expansion, 30½in., 44in., 63½in. and 91in. by 60in. stroke, pressure 230 lb. per square inch; constructed by the builders; trial trip, November 7th.

Pass of Leny, oil tanker; built by Blythswood Shipbuilding Company, Ltd., to the order of Bulk Oil Steamship Company, Ltd.; petroleum in bulk. Engines, triple-expansion, 15in., 25½in., 41in. diameter by 30in. stroke, pressure 180 lb. per square inch; constructed by Aitchison Blair, Ltd., of Clydebank; a speed of 10½ knots was attained on trial trip, November 7th.

Lady Somers, twin-screw steamer; built by Cammell Laird and Co., Ltd., to the order of Canadian National (West Indies) Steamships, Ltd., Montreal; dimensions, 438ft. by 60ft. by 32ft. 9in.; passengers and cargo. Engines, Parsons geared turbines; launch, November 13th.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

The Midland Wire Rope Company, of Hucknall, has appointed the firm of Messrs. Thos. Vickers, 14, New-street, Birmingham, as its selling agent for the Midland Counties and for its export trade.

Mr. Thos. L. Miller, M. Inst. C.E., M.I. Mech. E., M.I.E.E., consulting engineer, of 316, Royal Liver Building, Liverpool, asks us to announce that he will retire from active practice at the end of the present year.

The English Electric Company, Ltd., asks us to announce that its Newcastle office, which has hitherto been situated at 64–68, Collingwood-buildings, will, on and after to-morrow, November 17th, be removed to Carliol House, Newcastle-on-Tyne. Telephone numbers, Central 3033/4; telegraphic address "Enelectico, Newcastle-on-Tyne."

CONTRACTS.

The General Electric Company, Ltd., London, has received an order from H.M. War Office for the supply of Pearl Osram gas-filled electric lamps for use in various home service stations.

Sir W. G. Armstrong, Whitworth and Co., Ltd., have secured an order for ten locomotives and tenders for the Great Western of Brazil Railway Company, Ltd. These locomotives will be shipped to Pernambuco in fully erected condition.

The Associated Portland Cement Manufacturers, Ltd., have received an order for the supply of cement for the new Lacroze subway from Chacarita to Plaza Lavalle and the New Port, Buenos Aires. The total cost of the subway will be approximately £10,000,000, and one single crossing at the corner of Calles Rio de Janeiro and Triunvirate will cost £50,000.

Simon-Carves, Ltd., of Manchester, has received from the Sheffield Coal Company, Ltd., an order for two water-tube boilers, each capable of evaporating 30,000 lb. to 40,000 lb. per hour at 210 lb. pressure, together with four unit type pulveriaers for pulverised fuel firing for the Beighton Colliery, Yorkshire. In addition, the boilers are to be equipped for coke oven gas firing, and four Eickworth turbo-gas burners are to be supplied by Messrs. Simon-Carves for each boiler. The order also comprises superheaters, economisers, valves, fittings, instruments, feed pumps, a gas booster, two 20-ton coal bunkers, an elevator, a conveyor, and a complete new boiler-house building.

CATALOGUES.

Crofts (Engineers), Ltd., Thornbury, Bradford.—The firm's stock catalogue, a 220-page book of power transmitting appliances of all types and sizes.

The Unbreakable Pulley and Millgearing Company, Ltd., West Gorton, Manchester.—1928 pocket catalogue of shafting, bearings, hangers, pulleys, &c.

Wild-Barfield Electric Furnaces, Ltd., North-road, N. 17.—Heat treatment bulletin, "The Hardening and Tempering of High-speed Steel," by A. R. Page.

Edward Bennis and Co., Ltd., 28, Victoria-street, S.W. 1.—A catalogue on boiler house elevators, also one on natural draught coking stokers and self-cleaning furnaces.

Siemens Brothers, Ltd., Caxton House, Westminster, S.W. 1.—Catalogue of telephones and accessories. Also Catalogue 820 dealing with thermo-electric pyrometers.

The Portland Cement Selling and Distributing Company, Ltd., 20, Buckingham-gate, London, S.W. 1.—"Standard Practice for the Manufacture of Concrete Blocks."

General Electric Company, Ltd., Magnet House, Kingsway, W.C. 2.—"G.E.C. Illuminating Engineering Practice for Factories, Workshops, Warehouses and Factories."

Charles Churchill and Co., Ltd., 9–15, Leonard-street, E.C. 3.—Catalogues of the firm's exhibits of machine and small tools at the recent Olympia Machine Tool Exhibition.

Sterling Foundry Specialities, Ltd., London-road, Bedford.—Catalogue 37, giving full information on the firm's rolled steel moulding boxes and tubular foundry wheelbarrows.

Fescol, Ltd., 101, Grosvenor-road, London, S.W. 1.—Brochure No. 17 on electro-chemical deposition of metals entitled "An Industrial Revolution: Erosion and Corrosion Eliminated."

Drayton Regulator and Instrument Company, Ltd., West Drayton, Middlesex.—Loose-leaf folder on the "Drayton" hydraulic or pneumatic operating gear for automatic regulators.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	18/- to 21/6
(1) Spanish	18/- to 22/6
(1) N. African	18/- to 22/6
N.E Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 14 0	—
No. 1 Foundry	3 15 0 to 3 16 0	—
No. 3 Foundry	3 11 0	—
N.E. Coast—		
Hematite Mixed Nos.	3 10 0	3 10 0
No. 1	3 11 0	3 11 0
Cleveland—		
No. 1	3 8 6	3 8 6
Silicious Iron	3 8 6	3 8 6
No. 3 G.M.B.	3 6 0	3 6 0
No. 4 Foundry	3 5 0	3 5 0
No. 4 Forge	3 4 6	3 4 6
Mottled	3 4 0	3 4 0
White	3 4 0	3 4 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
„ „ Foundry	3 2 6	—
(3) Northampton—		
Foundry No. 3	2 17 0 to 2 18 0	—
Forge	2 13 6	—
(3) Derbyshire—		
No. 3 Foundry	3 0 0 to 3 1 0	—
Forge	2 16 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 0 0	—
No. 4 Forge	2 17 6	—
Basic	2 19 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 0 0 (a) / 4 2 6 (b) / 4 5 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
Double Best Bars	11 5 0	—
Treble Best Bars	11 15 0	—
Lancs.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	10 10 0	—
Best Bars	11 0 0	—
Hoops	12 10 0	—
Midlands—		
Crown Bars	9 2 6 to 10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 12 6 to 8 17 6	—
Gas Tube Strip	10 15 0 to 10 17 6	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export £ s. d.
(5) Scotland—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ¾in. and up	8 7 6	7 12 6
Sections	7 17 6	7 2 6
Steel Sheets, ¼in.	8 15 0	8 12 6
Sheets (Gal.Cor. 24 B.G)	13 10 0 .. 13 12 6 to 13 15 0	

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 15 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	7 12 6	—
Soft Billets	6 15 0	—
N.W Coast—		
Barrow—		
Heavy Rails	8 0 0	—
Light Rails	8 5 0 to 8 10 0	—
Billets	6 15 0 to 9 15 0	—
Manchester—		
Bars (Round)	8 17 6	—
„ (Small Round)	7 17 6 to 8 0 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 12 6 to 8 17 6	—
„ (Lancs. Boiler)	9 10 0 to 9 15 0	—
Sheffield—		
Siemens Acid Billets	9 5 0 to 9 10 0	—
Hard Basic	7 2 6 and 7 12 6	—
Intermediate Basic	7 0 0	—
Soft Basic	6 10 0	—
Hoops	9 0 0	—
Soft Wire Rods	7 5 0 to 7 10 0	—
Midlands		
Small Rolled Bars	7 15 0 to 8 0 0	—
Billets and Sheet Bars	6 7 6 to 6 10 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 10 0 to 13 12 6	—
Angles	7 17 6	—
Joists	7 17 6	—
Tees	8 17 6	—
Bridge and Tank Plates	8 12 6	—
Boiler Plates	11 0 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/- to 18/1½
Block Tin (cash)	230 0 0
„ (three months)	225 0 0
Copper (cash)	67 18 9
„ (three months)	68 7 6
Spanish Lead (cash)	20 18 9
„ (three months)	21 5 0
Spelter (cash)	24 12 6
„ (three months)	24 7 6
Manchester—	
Copper, Best Selected Ingots	73 17 6
„ Electrolytic	75 10 0
„ Strong Sheets	98 0 0
„ Tubes (Basis Price), lb.	0 1 1½
Brass Tubes (Basis Price), lb.	0 1 0½
„ Condenser, lb.	0 1 2½
Lead, English	22 15 0
„ Foreign	21 12 6
Spelter	24 15 0
Aluminium (per ton)	£107

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 10 0	7/6
„ „ 6 p.c. to 8 p.c.	£20 10 0	7/-
„ „ 8 p.c. to 10 p.c.	£20 0 0	6/-
„ „ Specially refined		
„ „ Max. 2 p.c. carbon	£33 0 0	12/-
„ „ „ 1 p.c. carbon	£37 0 0	15/-
„ „ „ 0·70 p.c. carbon	£41 0 0	17/-
„ „ „ carbon free	1/- per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home; £13 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/- per unit	
„ „ 75 p.c.	£19 0 0 scale 6/- per unit	
„ Vanadium	14/- per lb.	
„ Molybdenum	4/3 per lb.	
„ Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£170 to £175	
Ferro-Cobalt	9/- per lb.	

FUELS.

SCOTLAND.
(*Prices not stable.*)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	13/9
„ „ Ell	16/-
„ „ Splint	16/- to 16/9
„ „ Trebles	14/9 to 15/6
„ „ Doubles	13/9 to 14/-
„ „ Singles	12/6 to 12/9
Ayrshire—	
(f.o.b. Ports)—Steam	13/6
„ „ Jewel	15/6
„ „ Trebles	15/6 to 16/-
Fifeshire—	
f.o.b. Methil or Burntisland—Steam	12/9 to 13/-
Screened Navigation	15/-
Trebles	15/6 to 16/6
Doubles	13/6
Singles	12/9
Lothians—	
(f.o.b. Leith)—Best Steam	13/- to 13/6
Secondary Steam	12/6 to 12/9
Trebles	15/6 to 16/6
Doubles	13/6 to 13/9
Singles	12/9

ENGLAND.

	Inland.	Export.
(8) N.W. Coast—		
Steams		25/6
Household		36/6 to 51/-
Coke		22/6 to 23/6
Northumberland—		
Best Steams		14/-
Second Steams		13/- to 13/6
Steam Smalls		9/- to 9/6
Unscreened		11/9 to 12/-
Household		21/- to 27/-
Durham—		
Best Gas		14/9
Second		13/- to 13/3
Household		21/- to 27/-
Foundry Coke		18/6 to 19/6
Sheffield—		
Best Hand-picked Branch	26/- to 27/6	—
Derbyshire Best Bright House	23/- to 24/6	—
Best House Coal	20/6 to 21/6	—
Screened House Coal	17/- to 18/-	—
„ „ Nuts	16/- to 18/-	—
Yorkshire Hards	14/6 to 16/-	—
Derbyshire Hards	14/6 to 16/-	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	4/6 to 6/-	—
Smalls	3/6 to 4/-	—
Blast-furnace Coke (Inland)	13/6 at ovens	
Furnace and Foundry Coke (Export), f.o.b.		19/- to 19/6

(9) SOUTH WALES.

	Export.
Cardiff—	
Steam Coals :	
Best Smokeless Large	19/3 to 19/6
Second Smokeless Large	18/- to 19/3
Best Dry Large	17/9 to 18/6
Ordinary Dry Large	17/ to 17/3
Best Black Vein Large	17/6 to 17/9
Western Valley Large	17/- to 17/3
Best Eastern Valley Large	16/6 to 17/-
Ordinary Eastern Valley Large	16/3 to 16/6
Best Steam Smalls	12/6 to 13/-
Ordinary Smalls	10/6 to 12/-
Washed Nuts	18/- to 20/-
No. 3 Rhondda Large	19/6 to 20/-
„ „ Smalls	14/- to 14/6
No. 2 „ Large	16/- to 16/6
„ „ Through	14/6 to 15/6
„ „ Smalls	11/- to 12/-
Foundry Coke (export)	27/- to 37/-
Furnace Coke (export)	19/- to 21/-
Patent Fuel	20/- to 21/6
Pitwood (ex ship)	30/6 to 31/6
Swansea—	
Anthracite Coals :	
Best Big Vein Large	34/- to 35/6
Seconds	24/6 to 28/6
Red Vein	22/- to 27/-
Machine-made Cobbles	40/- to 43/6
Nuts	36/- to 43/6
Beans	23/6 to 25/-
Peas	18/- to 18/6
Breaker Duff	8/- to 8/6
Rubbly Culm	10/9 to 11/3
Steam Coals :	
Large	17/6 to 18/6
Seconds	16/- to 17/-
Smalls	12/- to 12/6
Cargo Through	15/- to 16/-

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 12/6 joists and 10/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our own Correspondent in Paris.)

The Trade Situation.

In the foreign trade has declined for some months past, the situation at home has steadily improved, and there appears to be a general activity in the iron, steel and engineering trades. There is every indication that this state of things will continue, principally because an increasing quantity of material is going into consumption for carrying out public works, but also because, since the franc was stabilised, there has been a recrudescence of constructional activity all round. Nevertheless, in one or two departments the outlook is not so good, notably amongst locomotive and wagons builders, who were recently receiving quite a large number of orders. Now that further contracts are being withheld, however, the outlook has become less promising. It is expected also that some foreign trade will be diverted to this country as the result of the lock-out in the Ruhr, which is extending to other provinces in a way that points to a serious struggle in Germany against the agitation for higher wages. The struggle has long been foreshadowed in view of the determined attitude of the men's Unions, which have made it a point to put wages on a level with the higher scale existing in some other countries. Their claims were partially conceded by an arbitration award which the Government endeavoured to make compulsory, but the employers refused to recognise the arbitration because they affirmed that, with the increased railway and other charges, they could not pay higher wages without putting up prices to such an extent as to shut them out entirely from foreign markets. It is not expected that the lock-out will be of long duration, but while it lasts its effect tends to strengthen the industrial position in this country.

The Motor Trade.

The trend of the motor car industry is regarded as showing that there can be only one way to prevent an increasing importation of American cars or a partial absorption of the home industry by American capital. Efforts have been made, particularly in Italy, to bring about a European combination of manufacture, which would offer a united front to the United States invasion. It is believed that such an organisation would allow of cars being produced under much the same conditions as in the United States, and would, at the same time, permit of measures being taken to exclude American cars. The scheme is so vast and is complicated by so many conflicting interests that French motor car firms are doubtful whether it can be carried through successfully. They are endeavouring to deal with the problem by modernising methods and employing the most economical plants, which is the main reason for the better demand that has been experienced for some time past for foreign machine tools, and the fact of the leading firms continuing busy shows that their efforts are meeting with success. Nevertheless, a considerable amount of American capital has recently gone into the French motor car industry, and it is generally believed that Transatlantic finance is behind a make of small car which was recently introduced on the market.

The Rail Union.

At the last meeting of the Rail Union in Brussels the continental rail makers endeavoured to secure from British manufacturers an assurance that they would either pay the stipulated penalty for exceeding the quota of rails sold abroad and in the Colonies and Dominions, or that they would abstain from exporting to those markets for a definite period. The latter proposal could not possibly be accepted, because it would have enabled continental rail makers to secure a permanent footing in British markets, and as regards the penalty, the British firms declared that the excess exports were inevitable since continental makers would have been unable to execute the exceptionally heavy orders that were offered to British rail makers. Moreover, the penalties could not be enforced during the existence of the Rail Union. The matter was then adjourned to allow of the British rail makers to reconsider their decision, and their reply was recently received by the Union. The nature of the reply has not been made known, but it is believed to be a refusal to accept all the claims of the continental makers. There has been some talk of a possible crisis in the Rail Union, but, in view of the necessity of maintaining it, it is nearly certain that a compromise will be effected.

New Railways.

The activity of French railway construction is observable in the number of new lines which have been officially opened recently, the latest being the railway between Casablanca and Marrakech in Morocco. That line completed the great North African railway between Gabès and Marrakech. As the constructions proceeded there was a continuous and satisfactory development of traffic, and the railway has already done much for the prosperity of Morocco. Other lines opened were the railway through the Vosges from Saint-Dié to Saales and the line between Nice and Coni, in Italy, while of still greater importance are the two new railways through the Pyrenees, one of which was recently opened, while the other will be opened in the course of next year. Thus, during the course of a few months communication has been established through the three great mountain ranges by means of railways, which, in many respects, are of particular interest in the way of tunnelling and in the methods of bridging awkward valleys. One of the viaducts on the Nice-Coni line is supported on a skew arch across a narrow valley, while spiral tunnels have become an ordinary feature in mountain railway construction. There has been particular activity in railway building during the past year or two owing to the necessity of terminating works that had remained more or less in abeyance for a considerable time previously, and in view of the way in which many awkward problems have been dealt with in the Alps and the Pyrenees, the new undertakings show distinct progress in railway engineering.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TRANSMISSION OF POWER.

297,294. April 13th, 1928.—Belt Pulleys, L. V. Fast Sörlands Industrikkontor, Kristiansand, Norway.

According to this invention, a belt pulley is made in two halves bolted together and is provided with a recess in the rim to house an inflatable pneumatic tube, a valve passage being provided in one side of the recess. A cover for this tube has beads which engage in grooves formed in the recessed portion of the rim of the pulley, so that when the driving belt is in position its tension can be varied by inflating the tube. Several

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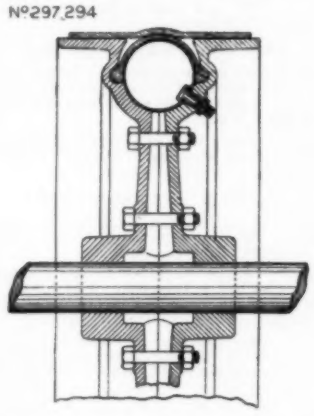

such recesses may be provided in the rim of the pulley, each containing a pneumatic tube mounted in the manner described. By inflating the tube the cover is caused to press with the desired pressure against the inner surface of the belt. If in the course of time the tension of the belt diminishes, the air tube is pumped up further until the belt again has the desired tension. In this manner the belt can, if necessary, be subsequently tensioned successively several times.—*September 20th*, 1928.

MEASURING AND TESTING INSTRUMENTS.

297,261. December 23rd, 1927.—Improvements in or relating to Thermo-electric Pyrometers, George Edward Lloyd, of 8, Portnall-road, London, W. 9, and Electroflo Meters Company, Ltd., of Abbey-road, Park Royal, London, N.W. 10.

The object of this invention is to provide means whereby, in the event of breakage of the thermo-couple or the leads connecting thereto, a current supplied from a suitable source of E.M.F. is caused to traverse the instrument and produce a deflection, which in itself may constitute a warning of the breakage, or which may be arranged to actuate a suitable alarm or control device. Under the normal conditions, the thermo-couple circuit comprises the thermo-couple A, adjustable resistance B, fixed resistances C and D, adjustable resistance E, and moving coil F, and the instrument deflects according to the E.M.F. generated in the couple in the usual manner. The resistances G and H form a shunt to the moving coil F and resistance

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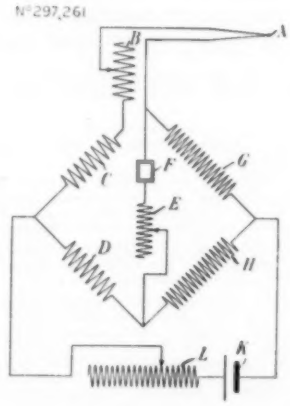

E, but as they are of relatively high resistance, the working current available in the moving coil is not substantially decreased. As the Wheatstone bridge system is balanced, the reading of the instrument is not affected by the current in the bridge arms due to the cell K. If, however, the thermo-couple breaks, the resistance of the arm in which it is connected may be considered infinite, and the bridge system is thrown out of balance, current passing through the moving coil to produce deflection preferably towards the full-scale reading, and to actuate a suitable alarm or control device. There is the possibility of changes in the resistance of the thermo-couple, on variation of temperature, throwing the bridge system slightly out of balance and thus producing a slight error in the reading of the instrument, but this error may be reduced to negligible proportions by operating with the resistance L at a sufficiently high value to limit the current in the bridge system to an amount only just sufficient to produce the required deflection on breakage of the thermo-couple.—*September 20th*, 1928.

MINING MACHINERY.

297,249. November 30th, 1927.—Rock Drills, A. T. Holman and P. M. Holman, Camborne, Cornwall.

The operation of the valve gear of this rock drill is described in the specification as follows:—It is assumed that the hammer piston A has reached the end of its stroke towards the left, and has started to move towards the right, driving fluid passing to the left-hand face of the piston through the passage comprising the space between the bridge B and the upper face of the valve C. As the piston travels towards the right, air from the left-hand end of the cylinder is expelled direct first through the free exhaust port D and subsequently through the ports E, F and D until the port E is closed by the piston. Thereafter further movement of the piston towards the right compresses air in the right-hand end of the cylinder, and the air pressure thus produced is transmitted through the conduit H to the under face of the valve C. Simultaneously with closing of the conduit E by the piston, or almost immediately thereafter, the left-hand end of the piston uncovers the free exhaust port D, and the pressure of the driving fluid in the left-hand end of the piston is thereby suddenly reduced by the rush of air through the exhaust port D. The compression produced in the right-hand end of the cylinder by the further travel of the piston A towards that end causes a compression of air through the port H to the underside of the valve C sufficient to lift the latter and thereby to cut off the admission of driving fluid to the left-hand end of the cylinder and admit driving fluid to the right-hand end thereof through the conduit H. When this position has been reached, the com-

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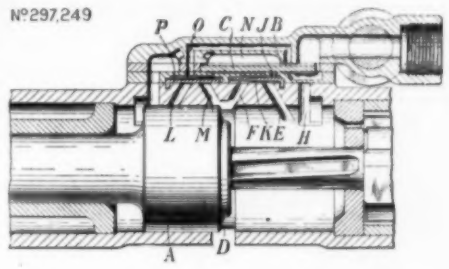

pressed driving fluid also passes through a port J to the upper surface of the pressure release valve K, so that it drops and is held downwardly to close connection between the conduits E and F, thereby preventing driving fluid from escaping through the conduit E to the free exhaust port D. The pressure of driving fluid in the right-hand end of the cylinder causes the piston to travel towards the left, and during its travel the cycle of operations is reversed, air being first exhausted through the free exhaust port D, and subsequently through the conduits L and M to the exhaust port D. After the conduit L is closed, air is compressed in the left-hand end of the cylinder, and immediately the pressure from the right-hand end is released by the uncovering of the exhaust port D, the compression from the left-hand end of the cylinder, which passes through the conduit N on to the top of the valve C, forces the latter down to the lower end of its beat, thereby closing the conduit H and opening the passage N to the main fluid supply. The whole cycle of operations above described then recommences, the pressure of the driving fluid passing through the conduit O to the upper surface of the pressure release valve P, thereby allowing the latter to close, it having been opened by the air pressure in the left-hand end of the cylinder as the piston travelled towards that end.—*September 20th*, 1928.

MOTOR CARS AND ROAD TRAFFIC.

289,899. May 5th, 1928.—Improvements in Current-collecting Devices for Electric Railways and the like, Metallbank und Metallurgische Gesellschaft Aktiengesellschaft, of 45, Bockenheimer Anlage, Frankfurt-on-the-Main, Germany.

This invention relates to current-collecting devices for electric railways and the like. On electric railways and tramways the trolley wires are subjected to excessive wear, owing to the sliding friction of the collecting devices. The invention relates

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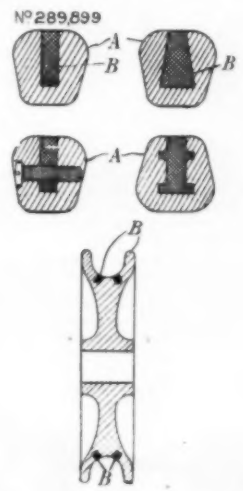

to a current-collecting device in which solid lubricating agents, such as graphite or talc, are burnt into recesses. In the upper drawings A indicates the sliding collecting device and B the groove, packed with graphite. Various methods of holding the graphite are shown in these drawings, whilst the lower drawing shows a trolley wheel provided with graphite at the points B. For the purpose of securing the graphite in the grooves of the trolley wheel, any of the schemes shown in the upper drawings may be employed.—*October 4th*, 1928.

MISCELLANEOUS.

285,434. February 13th, 1928.—Improved Process of Manufacturing Incandescent Cathodes for Electric Discharge Devices, N. V. Philips' Gloeilampenfabrieken, of Emmasingel 6, Eindhoven, North Brabant, Netherlands.

This invention has reference to a process of manufacturing incandescent cathodes for electric discharge devices, and more particularly incandescent cathodes, which, at least partly, consist superficially of one or more of the alkaline earth oxides. Incandescent cathodes manufactured by the application of alkaline earth oxides to a wire have in many respects unfavourable properties. It has been found that the properties of oxide cathodes generally, and of those of the kind referred to more particularly, can be improved if, in accordance with the inven-

tion, the oxide-coated cathode is heated in an oxidising atmosphere. An incandescent cathode manufactured by the process according to the invention may comprise a metal core on which a film of alkaline earth oxide is mounted. This film of oxide may be applied by immersion of the metal core in, for example, molten barium hydroxide, the cathode being then heated so that the water which is combined in the barium hydroxide is given up and an electrode coated with barium oxide is produced. After that the electrode produced is heated in an oxidising atmosphere —for example, of oxygen—to about 1000 deg. Cent. It is also possible to manufacture an incandescent cathode having a tungsten core on which a wire of nickel is helically wound, the wire having on it a layer of one or more earth alkaline oxides —for example, barium oxide—whereupon the cathode is heated in an oxidising atmosphere.—*October 4th*, 1928.

296,323. May 24th, 1927.—Improvements in and relating to Sound Transmitters Involving the Use of Light Waves, John Neale, 15, Acacia-road, St. John's Wood, London, N.W. 8.

This invention relates to an improved sound transmitter involving the use of light waves, and its object is to secure greater accuracy and efficiency in reproduction than has hitherto been possible. A light sensitive cell A is connected in circuit with a source of current B and the secondary winding of a transformer C, whilst the primary of the transformer is connected to a receiver or other arrangement for reproducing sound. A source

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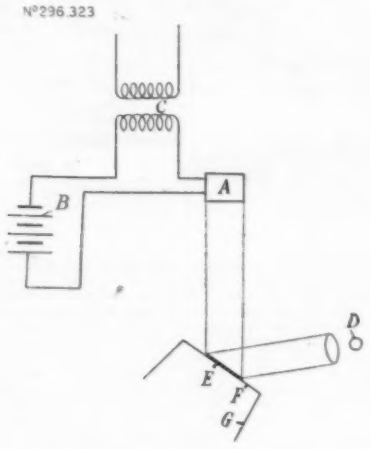

of light D illuminates the spot of metal E formed on the diaphragm F, which is acted upon by the sound vibrations collected by the horn G. The vibrations of the transmitting diaphragm in opposite directions have the effect of varying the curvature of the diaphragm, and consequently the intensity of illumination on the cell A. This results in changes in the electrical resistance of the light sensitive cell, and charges in the current in the transformer C. These variations of current eventually appear as sound vibrations set up by the diaphragm of the receiver.—*August 24th*, 1928.

297,251. December 9th, 1927.—Safety Razor Blades, A. V. Watson, 6, Clarence-road, St. Albans.

The object of the inventor in devising this razor blade was to make it better able to withstand the vibrations caused in cutting the beard, and to this extent it is somewhat similar to the

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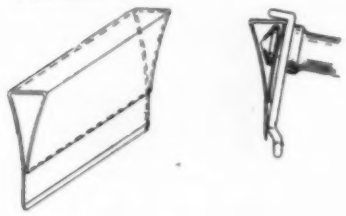

ordinary joiner's plane. The blade is formed by folding a thin sheet of steel, as shown in the illustration, and the edge of the fold is welded, or otherwise attached to the main part of the blade. No hint is given in the specification as to the method of manufacture.—*September 20th*, 1928.

297,657. April 12th, 1928.—Air Line Oilers, the Ingersoll-Rand Company, 15, Exchange-place, Jersey City U.S.A.

This oiler, for insertion in the air supply pipes of pneumatic tools, is really a development of the familiar needle oiler for shafting. The oil is contained in a reservoir A, while the supply of compressed air passes along the central passage B. Passing

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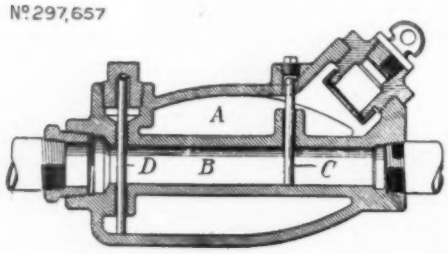


through the separating walls there are two pins C and D, which are a moderately free fit in their holes. These pins are vibrated by the pulsations in the flow of air and allow a slow feed of the oil into the air space. The reason for the addition of the second pin D is to ensure the action of the device when it is held in a vertical position.—*September 27th*, 1928.

Register of Patent Agents.—The intermediate and final examinations prescribed by the Board of Trade under the Register of Patent Agents Rules, 1920 and 1926, will be held by the Chartered Institute of Patent Agents at Staple Inn-buildings, London, W.C. 1, in April next. Particulars will be found among the official notices in the *Illustrated Official Journal (Patents)*, or can be obtained from the Registrar.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institution of Engineers and Shipbuilders in Scotland.—Grosvenor Restaurant, Gordon-street, Glasgow. The "James Watt" Lecture.

Institution of Locomotive Engineers: North-Eastern Centre.—Hotel Metropole, Leeds. "The Locomotive Smokebox," by Mr. E. Windle. 7 p.m.

Institution of Mechanical Engineers,—Storey's-gate, St. James's Park, Westminster, London, S.W. 1. "Power Transmission by Belts: An Investigation of Fundamentals," by Dr. H. W. Swift. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, Westminster, London, S.W. 1. Informal meeting. "Some Applications of Time and Remote Control Switches," by Mr. A. H. Croucher. 7.30 p.m.

SATURDAY, NOVEMBER 17TH.

Institute of British Foundrymen: Lancashire Branch, Junior Section.—College of Technology, Sackville-street, Manchester. "Shrinkage Holes in Small Grey Iron Castings," by Mr. P. A. Russell. 7 p.m.

Institution of Municipal and County Engineers.—Town Hall, Leeds. "Town Planning in Relation to the Municipal Engineer," by Mr. E. Willis. 2.30 p.m.

MONDAY, NOVEMBER 19TH.

Institution of Automobile Engineers.—At the College, Loughborough. Graduates' meeting. "Servo Equipment," by Mr. C. K. Speid. 7 p.m.

Institution of Automobile Engineers: Scottish Centre.—Royal Technical College, Glasgow. "The Comparative Merits of Road and Dynamometer Testing for Motor Vehicles," by Dr. E. C. Wadlow. 7.30 p.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, S.W. 1. Graduates' Section, London. "Automatic Combustion Control of Furnaces," by Mr. G. R. Bamber. 6.30 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Cantor Lecture. "Biology and Refrigeration: Lecture II.," by Dr. Franklin Kidd. 8 p.m.

TUESDAY, NOVEMBER 20TH.

Institution of Automobile Engineers.—Broadgate Café, Coventry Graduates' meeting. "Automobile Brakes," by Mr. L. H. Dawtrey. 7.15 p.m.

Institution of Automobile Engineers.—Engineering and Scientific Club, Queen-street, Wolverhampton. "The Comparative Merits of Road and Dynamometer Testing for Motor Vehicles," by Dr. E. C. Wadlow. 7.30 p.m.

Institution of Civil Engineers.—Great George-street, London, S.W. 1. "Mechanical Properties of British Rail Steels," by Professor W. E. Dalby, F.R.S. 6 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. "Diamonds." Lecture I., by Sir William Bragg, F.R.S. 5.15 p.m.

Sheffield Metallurgical Association.—198, West-street, Sheffield. "The Welding of Stainless Materials," by Mr. H. Bull and Mr. L. Johnson. 7.30 p.m.

TUESDAY AND WEDNESDAY, NOVEMBER 20TH AND 21ST.

Society of Glass Technology.—Stourbridge. Tuesday, Public Lecture. "Byzantine and Venetian Glass," by Mr. W. Butterworth, sen. 7.30 p.m. General meeting. Talbot Hotel, Stourbridge, on Wednesday. General discussion on "Glass-works Refractory Materials," introduced by Professor W. E. S. Turner, who will speak on "Recent Progress in the Study of Refractory Materials for the Glass Industry." 2.30 p.m.

WEDNESDAY, NOVEMBER 21ST.

Institute of Fuel.—Connaught Rooms, London, W.C. 2. Annual dinner. 7.15 p.m.

Institution of Automobile Engineers.—Savoy Hotel, Victoria Embankment, W.C. 2. Annual dinner and dance. 7 p.m.

Institution of Civil Engineers.—Great George-street, London, S.W. 1. Students' meeting. Address by Mr. H. G. Cousins. 6.30 p.m.

Newcomen Society.—At the Iron and Steel Institute, 28, Victoria-street, London, S.W. 1. Annual general meeting. "Statistical History of the Iron Trade, A.D. 1717–1765," by Mr. E. Wyndham Hulme. 5.30 p.m. Council meeting at 4 p.m.

Northampton Engineering College Engineering Society.—St. John-street, E.C. 1. "Seven Thousand Years of Shipping," by Mr. J. Foster-Petree. 5.30 p.m.

Royal Meteorological Society.—49, Cromwell-road, South Kensington. "On the Association of the Diurnal Variation of Electric Potential Gradient in Fine Weather with the Distribution of Thunderstorms Over the Globe," by Dr. F. J. W. Whipple; "Atmospheric Oscillations Shown by the Microbarograph," by Mr. N. K. Johnson; "On the Mean Maximum Rain Falling in a Time *t*," by Mr. H. Jameson. 5 p.m. The Meteorological Club will dine at 7 o'clock at the Hotel Vandyke.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. "Forestry in Sweden: Its Importance to and Influence in Great Britain," by Professor E. P. Stebbing. 8 p.m.

WEDNESDAY AND THURSDAY, NOVEMBER 21ST AND 22ND.

Institute of Fuel.—At the Institution of Electrical Engineers, Victoria Embankment, London, W.C. 2. November Conference. For programme, see page 528.

THURSDAY, NOVEMBER 22ND.

Institution of Civil Engineers: Birmingham and District Association.—Birmingham Chamber of Commerce. "Notes on a Storm Water Pumping Plant," by Mr. R. C. Moon. 6 p.m.

Institution of Structural Engineers.—10, Upper Belgrave-street, S.W. 1. "Recent Improvements in the Strength and Constructive Value of Portland Cement," by Mr. B. B. Butler. 6.30 p.m.

The Institution of Electrical Engineers.—Joint meeting with the British Institute of Radiology. In the Lecture Theatre of the Institution, Savoy-place, Victoria Embankment, W.C. 2. "The Electrical Equipment of X-ray Apparatus," by Mr. L. G. H. Sarsfield. 5.30 p.m.

FRIDAY, NOVEMBER 23RD.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. "A Survey of Cadmium," by Mr. C. F. Moore. 7.30 p.m.

Keighley Association of Engineers.—Queen's Hotel, Keighley. Ladies' night. "Romantic Britain," by Mr. J. Shuttleworth. 7.30 p.m.

Manchester Association of Engineers.—Engineers' Club, Albert-square, Manchester. "Electric Traction on Railways," by Mr. R. Brooks. 7.15 p.m.

SATURDAY, NOVEMBER 24TH.

Institution of Civil Engineers.—Students' visit to the reconstruction works of Waterloo Bridge.

MONDAY, NOVEMBER 26TH.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Cantor Lecture. "Biology and Refrigeration: Lecture III.," by Dr. Franklin Kidd. 8 p.m.

TUESDAY, NOVEMBER 27TH.

Institute of Metals: Birmingham Local Section.—Engineers' Club, Birmingham. "Electric Furnace Developments," by Mr. D. F. Campbell. 7 p.m.

Institution of Automobile Engineers.—Watergate House, Adelphi, London, W.C. 2. London Graduates. "Petrol-electric Transmission," by Mr. S. Miall. 7.25 p.m.

Institution of Electrical Engineers: North-Eastern Students' Section.—Newcastle-on-Tyne. Annual dinner.

Institution of Engineering Inspection.—Hyde Park Hotel, London. Annual reception and dance. 8.30 p.m.

Sheffield Metallurgical Association.—198, West-street, Sheffield. "Fighting Corrosion," by Mr. T. Henry Turner. 7.30 p.m.

The Institute of Metals: Birmingham Local Section.—In the Engineers' Club, Waterloo-street, Birmingham. "Electric Furnace Developments," by Mr. D. F. Campbell. 7 p.m.

The Institution of Electrical Engineers: North-Eastern Centre.—At the Central Station Hotel, Newcastle-on-Tyne. Annual dinner and reunion. 7 p.m.

WEDNESDAY, NOVEMBER 28TH.

Institution of Automobile Engineers: North of England Centre.—Engineers' Club, Manchester. "The Comparative Merits of Road and Dynamometer Testing for Motor Vehicles," by Dr. E. C. Wadlow. 7 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. "The Port of London," by Mr. J. H. Estill. 8 p.m.

THURSDAY, NOVEMBER 29TH.

Institution of Automobile Engineers.—Royal Hotel, Mill-street, Luton. Graduates' meeting. "Purchasing," by Mr. E. C. Thompson. 7.30 p.m.

Institution of Civil Engineers: Yorkshire Association.—Hotel Metropole, Leeds. "Some Experiments in Measuring the Strain in the Reinforcing Bars of Concrete Steel Beams," by Mr. J. Gilchrist. 7.30 p.m.

FRIDAY, NOVEMBER 30TH.

Institution of Automobile Engineers: Scottish Graduates.—Regent Restaurant, 51, West Regent-street, Glasgow. "Brakes," by Mr. W. P. Kirkwood. 8 p.m.

Institution of Electrical Engineers: South Midland Centre.—Grand Hotel, Birmingham. Annual dinner. 7 p.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, S.W. 1. Thomas Lowe Gray Lecture. "The Possible Vibration of a Ship's Hull under the Action of an Unbalanced Engine," by Professor W. E. Dalby, F.R.S. 6 p.m.

The Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Informal meeting. "The Manufacture of Decorative Metal Work," by Mr. C. W. Harvey. 7.30 p.m.

TUESDAY, DECEMBER 4TH.

Institution of Engineers and Shipbuilders in Scotland.—39, Elmbank-crescent, Glasgow. "Gear Transmission," by Dr. H. E. Merritt. 7.30 p.m.

WEDNESDAY, DECEMBER 5TH.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. "Fuel for Ships," by Sir Eustace Tennyson d'Eyncourt, F.R.S. 8 p.m.

The Institution of Automobile Engineers: Derby Graduates' Branch.—Joint meeting with the Derby Society of Engineers. Technical College, Derby. "The Heat Treatment and Mechanical Properties of Alloy Steels," illustrated by lantern slides, by Mr. J. H. Dickenson. 7.30 p.m.

FRIDAY, DECEMBER 7TH.

The Institution of Water Engineers.—Apartments of the Geological Society, Burlington House, W. (1) "The Consumption and Waste of Water, by Mr. John Bowman, M. Inst. C.E.; (2) "Legal Considerations relating to the Administration of Engineering Contracts," by Mr. E. J. Rimmer, A.M. Inst. C.E.; (3) "The Sandfields," by Mr. A. W. Burtt; (4) "The Corrosive Attack of Moorland Water on Concrete," by Messrs. W. T. Halcrow, M. Inst. C.E., G. B. Brook, F.I.C., M.I.M.M., and R. Preston. 10.30 a.m.

WEDNESDAY, DECEMBER 12TH.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. "Applications of Electricity to Medical Practice," by Mr. G. G. Blake. 8 p.m.

THURSDAY, DECEMBER 13TH.

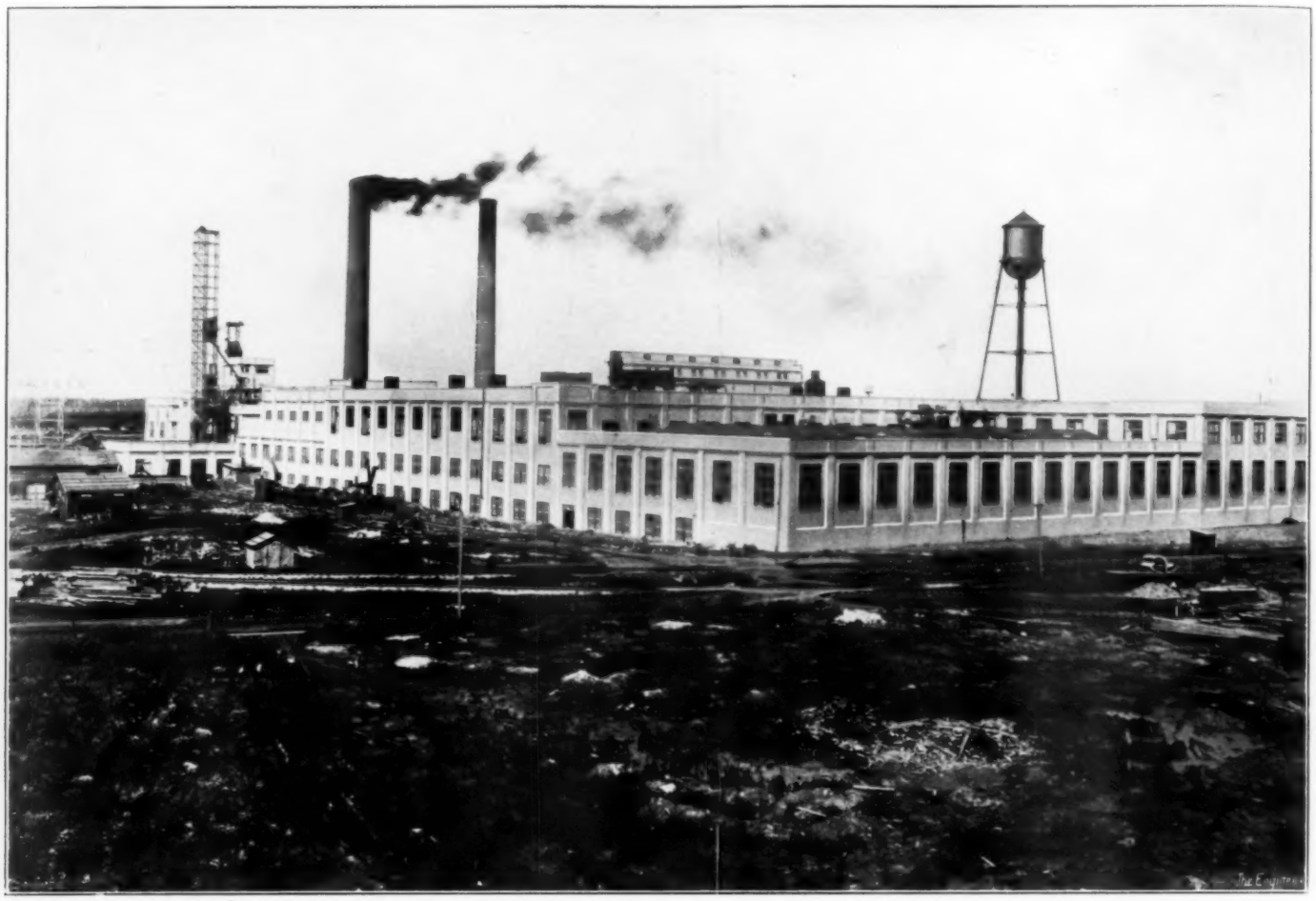
Institution of Civil Engineers: Yorkshire Association.—Hotel Metropole, Leeds. "Notes on Power Station Construction," by Mr. A. H. D. Markwick. 7.30 p.m.

SATURDAY, DECEMBER 15TH.

Institute of British Foundrymen: Lancashire Branch, Junior Section.—College of Technology, Sackville-street, Manchester. "The Application of the Microscope to the Study of Metals and Alloys," by Mr. G. Mohn. 7 p.m.

The British Association.—The British Association proposes to hold its annual meeting next year in South Africa. The meeting is to take place under the auspices of the South Africa Association for the Advancement of Science, the headquarters of which are at Johannesburg. In fact, the meeting will coincide with the twenty-seventh meeting of the South African Society. Owing to the fact that the visiting members will land at Cape Town, the first portion of the meeting will be held at that place from July 22nd to 28th, the party afterwards proceeding by rail to Johannesburg and Pretoria, *viâ* Kimberley, where the journey will be broken in order that a visit may be paid to the De Beers Consolidated Diamond Mines. Johannesburg, where further meetings will be held, will be reached on July 30th, and August 5th to 7th will be spent at Pretoria. Several additional tours have been arranged in connection with the visit.

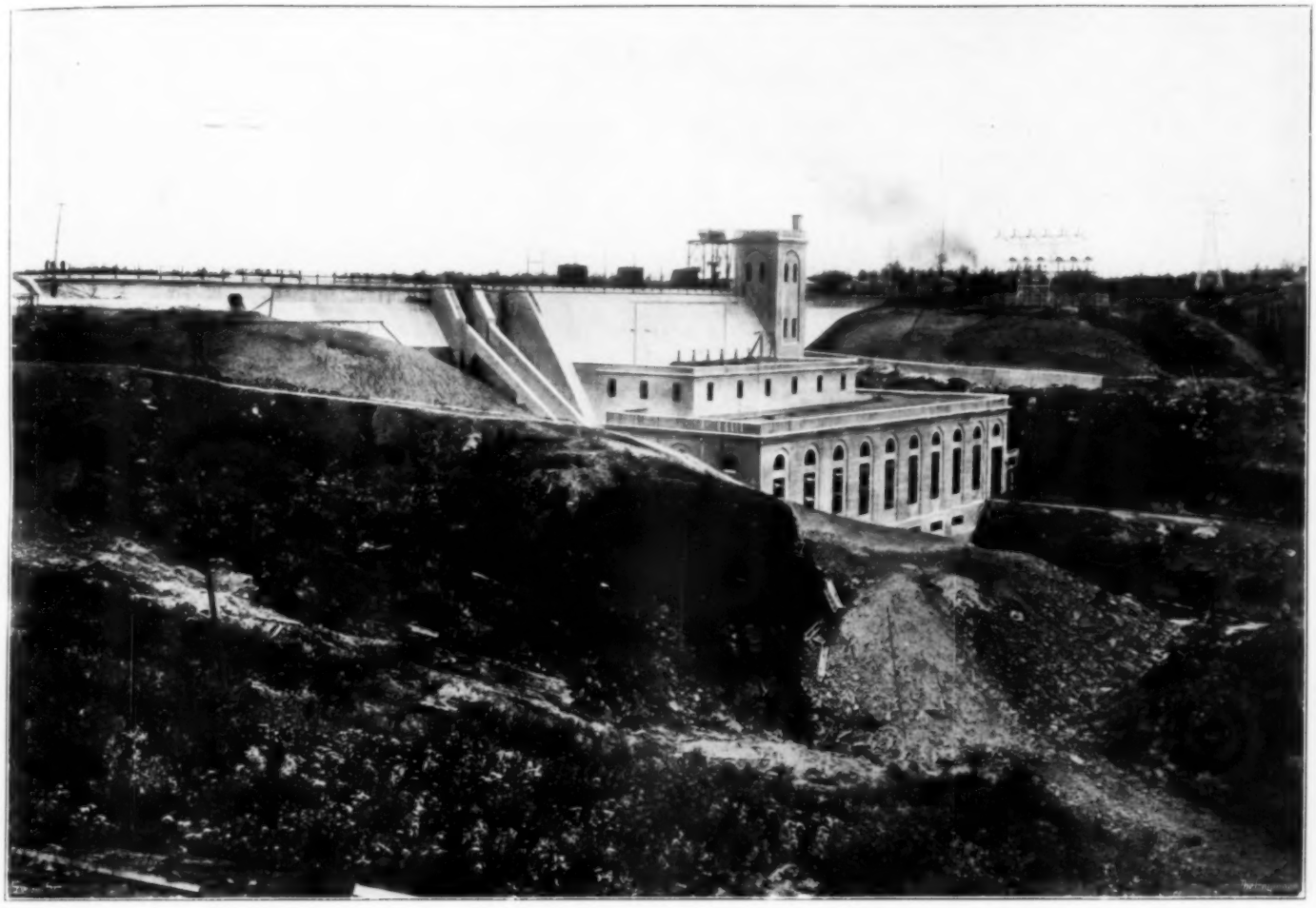
PAPER MILL AND HYDRO-ELECTRIC PR



THE PAPER MILL AT KAPUSKASING

UP-STREAM FACE OF DAM AT SMOKY FALLS ON THE MATTAGAMI RIVER

PER STATION IN NORTHERN ONTARIO



THE POWER-HOUSE AT SMOKY FALLS

DOWN-STREAM FACE OF DAM AT SMOKY FALLS